

CARL H. BUTTKE, INC.  
CONSULTING TRANSPORTATION ENGINEER

P.O. BOX 636 ■ PORTLAND, OREGON 97207 ■ 503 / 223-4728

REPORT ON

TRANSPORTATION

CITY OF HILLSBORO, OREGON

Prepared by: Carl H. Buttke, P.E.  
December 14, 1979





CARL H. BUTTKE, INC.  
CONSULTING TRANSPORTATION ENGINEER

P.O. BOX 636 ■ PORTLAND, OREGON 97207 ■ 503 / 223-4728

The Honorable Larry E. Johnson  
and Council Members  
City of Hillsboro  
205 S. Second Street  
Hillsboro, OR 97123

Dear Sirs:

This report concerning transportation within the City of Hillsboro is submitted in accordance with our agreement of October 19, 1978.

This report contains analyses of current traffic conditions, a forecast of future traffic conditions together with the development of alternative solutions to accommodate the future traffic. A detailed plan is provided with an implementation schedule to improve the City's transportation system over the next 20 years and to accommodate the future land use.

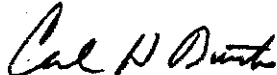
The City Engineering Department provided capital cost estimates for all the street improvement projects. From these estimates, a five year capital improvement was suggested.

Throughout the course of this project, I have worked closely with City staff in the Planning and Engineering Departments, attended neighborhood workshop sessions on the development of the Plan and coordinated this effort with the Oregon Department of Transportation, Washington County, TRI-MET and the Metropolitan Service District.

I appreciate the opportunity to have been of service to the City of Hillsboro on this project and in the event you have any questions concerning this report, please contact me at your convenience.

Sincerely,

CARL H. BUTTKE, INC.



Carl H. Buttke, P.E.  
President



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## SUMMARY

It is estimated that approximately 30,000 people live in the Hillsboro Planning Area and that approximately 8600 people are employed here. The City of Hillsboro actually had a population of approximately 26,000 in 1978 or 86 percent of the population of the planning area. The assumed growth for the year 2000 in the planning area is expected to result in some 55,000 people living here and some 25,000 to 29,000 people working here.

From the analyses of traffic flow, street capacity and accidents, it is concluded that the existing arterial streets are reaching their capacity limitations on Cornell Road, Main Street in the vicinity of Tenth Avenue, Tenth Avenue and T. V. Highway immediately east of Tenth Avenue. Other intersections have been identified as needing improvements to reduce a congestion problem or potential accident problem. Many of the residential collector streets are in need of repair or new pavement because they were never fully improved.

Public transportation is limited in Hillsboro to regional service connecting to cities to the east and west and a new local line.

By the year 2000, it is expected that the major east-west arterial streets within the City will experience capacity deficiencies far beyond the tolerable limits of motorists if the existing transportation system is not improved.

Major deficiencies in north-south circulation within the City exist today and will be magnified in the future.

Therefore, to accommodate the expected growth in population, employment and the resulting transportation needs, it is recommended that a transportation plan be implemented consisting of improved and expanded local and regional public transportation including light rail transit or an express bus system, an improved arterial and collector street network, a bikeway system and the development of carpool, vanpool and staggered work hour programs.

The recommended street system includes the development of arterial streets which surround the City and pass through it in the east-west direction. Collector streets would provide increased north-south traffic circulation as well as general intra-city circulation. Improved access to Sunset Highway is also proposed via Shute and Jackson Roads.

The following summarizes the major improvements recommended to the existing street system:

- Develop Cornell Road as a four lane arterial with left turn lanes.
- Develop the Ninth-Tenth Avenue one-way couplet system between Main and Cedar Streets.
- Develop Main and Washington Streets into a one-way couplet system west of 18th Avenue and Main into a three lane arterial east of 18th Avenue.
- Develop Evergreen Road into a two lane arterial street with left turn lanes.
- Improve First Avenue-Glencoe Road on the west and Cornelius Pass Road-216th-219th Avenues on the east as arterial roadways.
- Connect 25th and 28th Avenues between Evergreen and Main Streets.
- Develop Brookwood as a two lane collector street with left turn lanes between T. V. Highway and Evergreen Road.

A detailed description of the recommended plan including street standards, bikeways, truck routing, public transportation guidelines and an implementation schedule is contained in the text.



## INTRODUCTION

This report concerning transportation within the City of Hillsboro is submitted in accordance with our agreement of October 19, 1978.

## PURPOSE

The purpose of this report is to provide the City of Hillsboro with a plan for improving transportation conditions within the City and to accommodate travel throughout the City for the next 20 years. It is intended that this plan would become the transportation element of the City's Comprehensive Plan.

The analyses included an inventory of current traffic conditions, an assessment of the existing adequacy of the street system, forecasts of traffic for the year 2000, the development and testing of alternative street improvements to safely accommodate the future traffic, defining public transportation needs and the detailing of an implementation plan.

## GOALS AND GUIDELINES

The Oregon Land Conservation and Development Commission has established statewide planning goals and guidelines to be utilized in the development of a comprehensive plan. The goals are regulations to be followed by citizens and governments. The guidelines are not mandatory but are suggested directions for local governments to consider when developing comprehensive plans and applying goals.

Statewide goal 12, Transportation is as follows:

To provide and encourage a safe, convenient and economic transportation system.

A transportation plan shall (1) consider all modes of transportation including mass transit, air, water, pipeline, rail, highway, bicycle and pedestrian; (2) be based upon an inventory of local, regional and state transportation needs; (3) consider the differences in social consequences that would result from utilizing differing combinations of transportation modes; (4) avoid principal reliance upon any one mode of transportation; (5) minimize adverse social, economic and environmental impacts and costs; (6) conserve energy; (7) meet the needs of the transportation disadvantaged by improving transportation services; (8) facilitate the flow of goods and services so as to strengthen the local and regional economy; and (9) conform with local and regional comprehensive land use plans. Each plan shall include a provision for transportation as a key facility.

The guidelines developed by L.C.D.C. are as follows:

A. Planning

1. All current area-wide transportation studies and plans should be revised in coordination with local and regional comprehensive plans and submitted to local and regional agencies for review and approval.
2. Transportation systems, to the fullest extent possible, should be planned to utilize existing facilities and rights-of-way within the state provided that such use is not inconsistent with the environmental, energy, land-use, economic or social policies of the state.
3. No major transportation facility should be planned or developed outside urban boundaries on Class I and II agricultural land, as defined by the U.S. Soil Conservation Service unless no feasible alternative exists.
4. Major transportation facilities should avoid dividing existing economic farm units and urban social units unless no feasible alternative exists.
5. Population densities and peak hour travel patterns of existing and planned developments should be considered in the choice of transportation modes for trips taken by persons. While high density developments with concentrated trip origins and destinations should be designed to be principally served by mass transit, low-density developments with dispersed origins and destinations should be principally served by the auto.
6. Plans providing for a transportation system should consider as a major determinant the carrying capacity of the air, land and water resources of the planning area. The land conservation and development actions provided for by such plans should not exceed the carrying capacity of such resources.

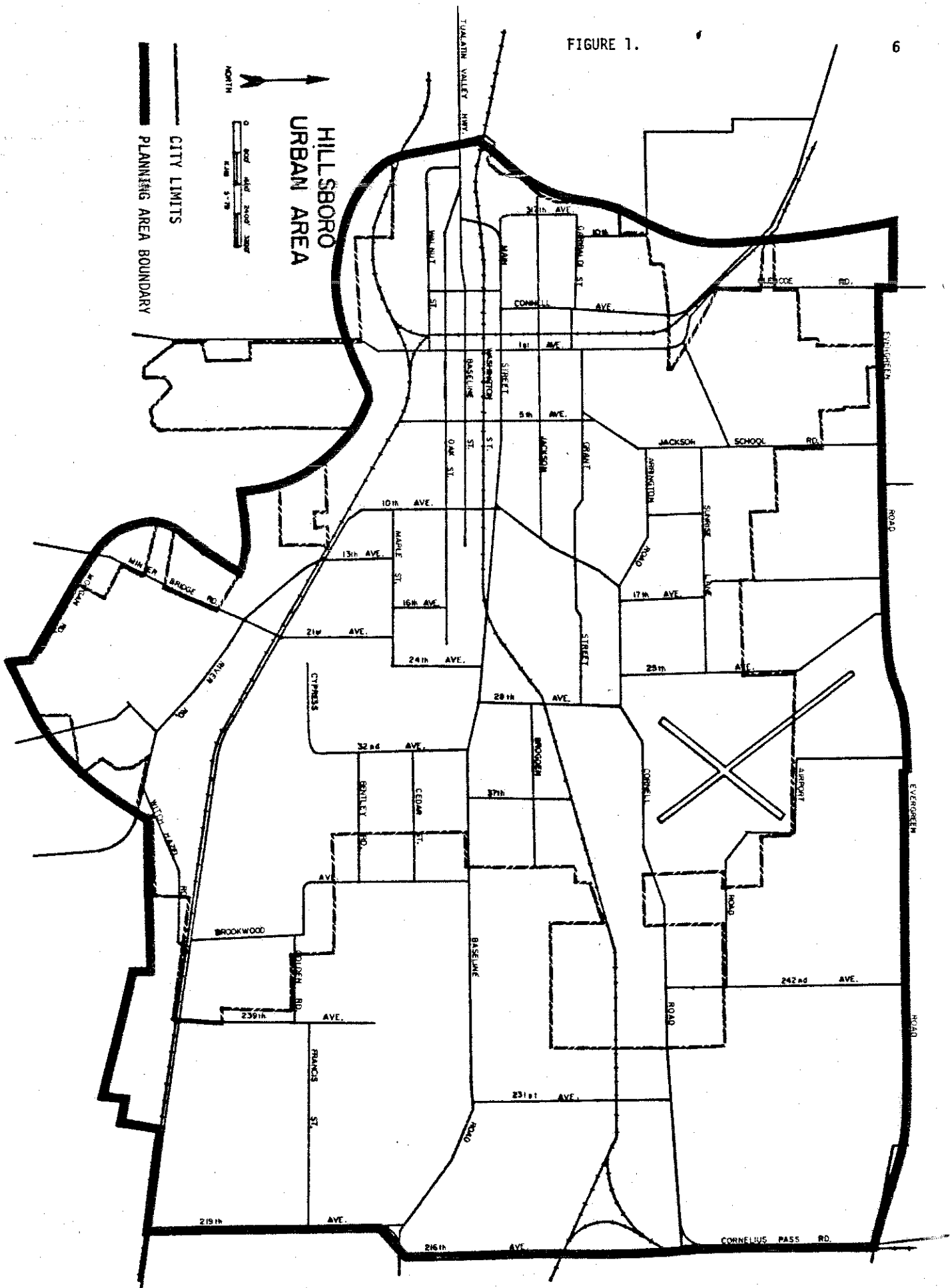
## B. Implementation

1. The number and location of major transportation facilities should conform to applicable state or local land use plans and policies designed to direct urban expansion to areas identified as necessary and suitable for urban development. The planning and development of transportation facilities in rural areas should discourage urban growth while providing transportation service necessary to sustain rural and recreational uses in those areas so designated in the comprehensive plan.
2. Plans for new or for the improvement of major transportation facilities should identify the positive and negative impacts on: (1) local land use patterns, (2) environmental quality, (3) energy use and resources, (4) existing transportation systems and (5) fiscal resources in a manner sufficient to enable local governments to rationally consider the issues posed by the construction and operation of such facilities.
3. Lands adjacent to major mass transit stations, freeway interchanges, and other major air, land and water terminals should be managed and controlled so as to be consistent with and supportive of the land use and development patterns identified in the comprehensive plan of the jurisdiction within which the facilities are located.
4. Plans should provide for a detailed management program to assign respective implementation roles and responsibilities to those governmental bodies operating in the planning area and having interests in carrying out the goal.

## PLANNING AREA

The planning area, as shown on Figure 1, is bounded on the west by McKay and Dairy Creeks, on the north by NW Evergreen Road, on the east by Cornelius Pass Road, SW 216th and 219th Avenues, and on the south by Tualatin Valley Highway, Witch Hazel Road, the Tualatin River and SW Morgan Road.

FIGURE 1.



## PRESENT AND FUTURE LAND USE

It is estimated that nearly 30,000 people live in the planning area and that approximately 8600 people are employed there. The assumed growth in the planning area is expected to result in some 55,000 people living there and some 25,000 to 29,000 people working there.

The City Planning Department made an inventory of all buildings and land use within the planning area in 1978. This inventory is summarized on Table 1.

The Planning Department also made a forecast of land use for the full development of the planning area which is expected to occur within the next 20 to 25 years. For analysis purposes, it is assumed that full development would occur by the year 2000. This forecast of land use is also included on Table 1.

The current employment of 8600 people within the planning area was estimated from employee surveys and checked by utilizing common employee densities<sup>1</sup> and the building inventory. The future employment was estimated on the basis of the forecast land use shown on Table 1 and common

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<sup>1</sup>Source: Carl H. Buttke, Inc.

TABLE 1

## CURRENT AND FORECAST YEAR 2000 LAND USE

Hillsboro Planning Area

|                         | 1978           | Year 2000       |
|-------------------------|----------------|-----------------|
| Single Family Dwellings | 7,400 D.U.     | 14,700 D.U.     |
| Multi Family Dwelings   | 2,300 D.U.     | 6,300 D.U.      |
| Mobile Homes            | 400 D.U.       | 900 D.U.        |
| Total Residential       | 10,100 D.U.    | 21,900 D.U.     |
| Retail/Service          | 1,350,000 S.F. | 2,570,000 S.F.  |
| Office/Government       | 565,000 S.F.   | 1,070,000 S.F.  |
| Industrial              | 170 Acres      | 1,160 Acres     |
| Schools                 | 9,400 Students | 18,000 Students |

Note: D.U. = Dwelling Unit

S.F. = Gross Square Feet of Building Space

Acres = Developed Acres

Source: Hillsboro Planning Department

employee densities. The estimate of current and year 2000 employment within the planning area by general category is shown on Table 2.

As indicated on Tables 1 and 2, it is forecast that the number of housing units and the amount of retail, service, office and government space and employment will approximately double by the year 2000. However, the industrial space and employment is assumed to increase by nearly seven times in the next 20 to 25 years.

TABLE 2

## EMPLOYMENT ESTIMATE

Hillsboro Planning Area

|                   | 1978 | Year 2000 |
|-------------------|------|-----------|
| Retail/Service    | 2400 | 4000      |
| Office/Government | 2100 | 4200      |
| Industrial        | 2600 | 19000     |
| Other             | 1500 | 1800      |
| Total             | 8600 | 29000     |

Source: City of Hillsboro Planning Department  
 Business Survey 1978, and  
 Carl H. Buttke, Inc.

## TRANSPORTATION INVENTORY

The Transportation Inventory for the Hillsboro Comprehensive Plan includes the measurement of current street traffic, a major street system inventory, an analysis of the existing street capacity, an analysis of accident locations, an inventory of public transportation service in Hillsboro and a measurement of travel characteristics.

### 1978 TRAFFIC

Traffic volumes on streets within the City were measured during the fall of 1978. Counts were made over a several day period with automatic traffic counters and manually at some locations to define the traffic flow pattern. Traffic volume measurements were also obtained from the files of the City for a historical examination and from the files of Washington County and the Oregon State Highway Division. These volumes were then adjusted for seasonal variations to reflect average weekday traffic conditions (average of Monday through Friday).

As indicated on Figure 2, Tualatin Valley Highway carries the highest volume of traffic in the City with volumes ranging between 24,000 to 27,000 vehicles on an average weekday in 1978.

Oak Street carries approximately 15,000 vehicles per weekday at the west end of the City and approximately 20,000 vehicles at 10th Avenue. Traffic on Baseline Street is slightly lower than that on Oak Street as shown on Figure 2. It appears that the westbound traffic utilizes both Baseline and Main Streets whereas the eastbound traffic generally utilizes Oak Street.

Traffic on Cornell Road west of Cornelius Pass Road varies between 12,000 and 14,000 vehicles per day as shown on Figure 2.

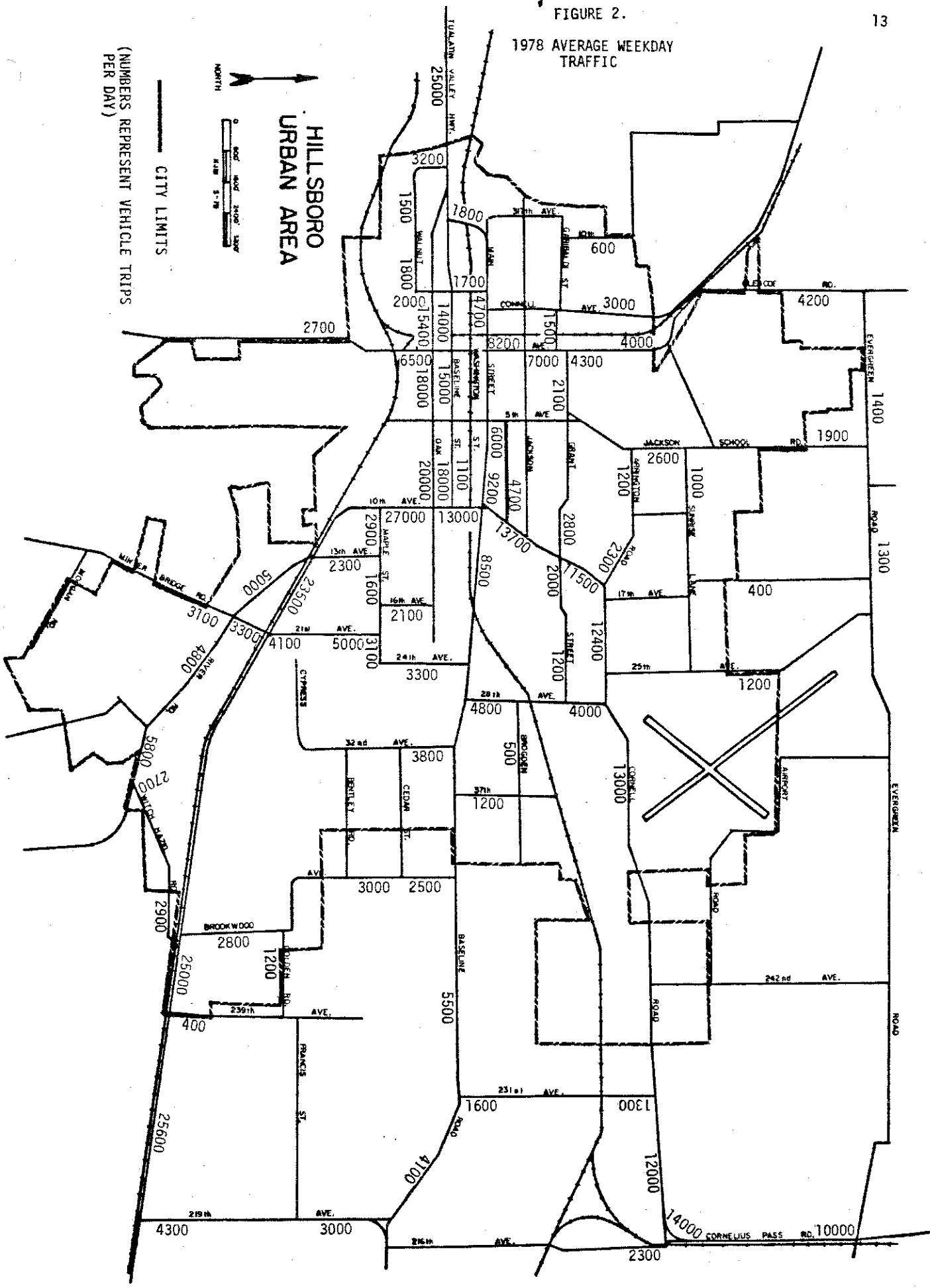
First Avenue carries slightly over 8000 vehicles per day in the vicinity of Main Street. North of Grant Street the traffic volume has been measured to be approximately 4000 vehicles per weekday. At the south side of the City the traffic on First Avenue is less than 3000 vehicles per weekday.

Traffic on Main Street-Baseline Road varies between 4000 vehicles per weekday at the east and west ends of the City and nearly 9000 vehicles per day immediately west of Tenth Avenue.

FIGURE 2.

1978 AVERAGE WEEKDAY  
TRAFFIC

(NUMBERS REPRESENT VEHICLE TRIPS  
PER DAY)





## MAJOR STREET INVENTORY

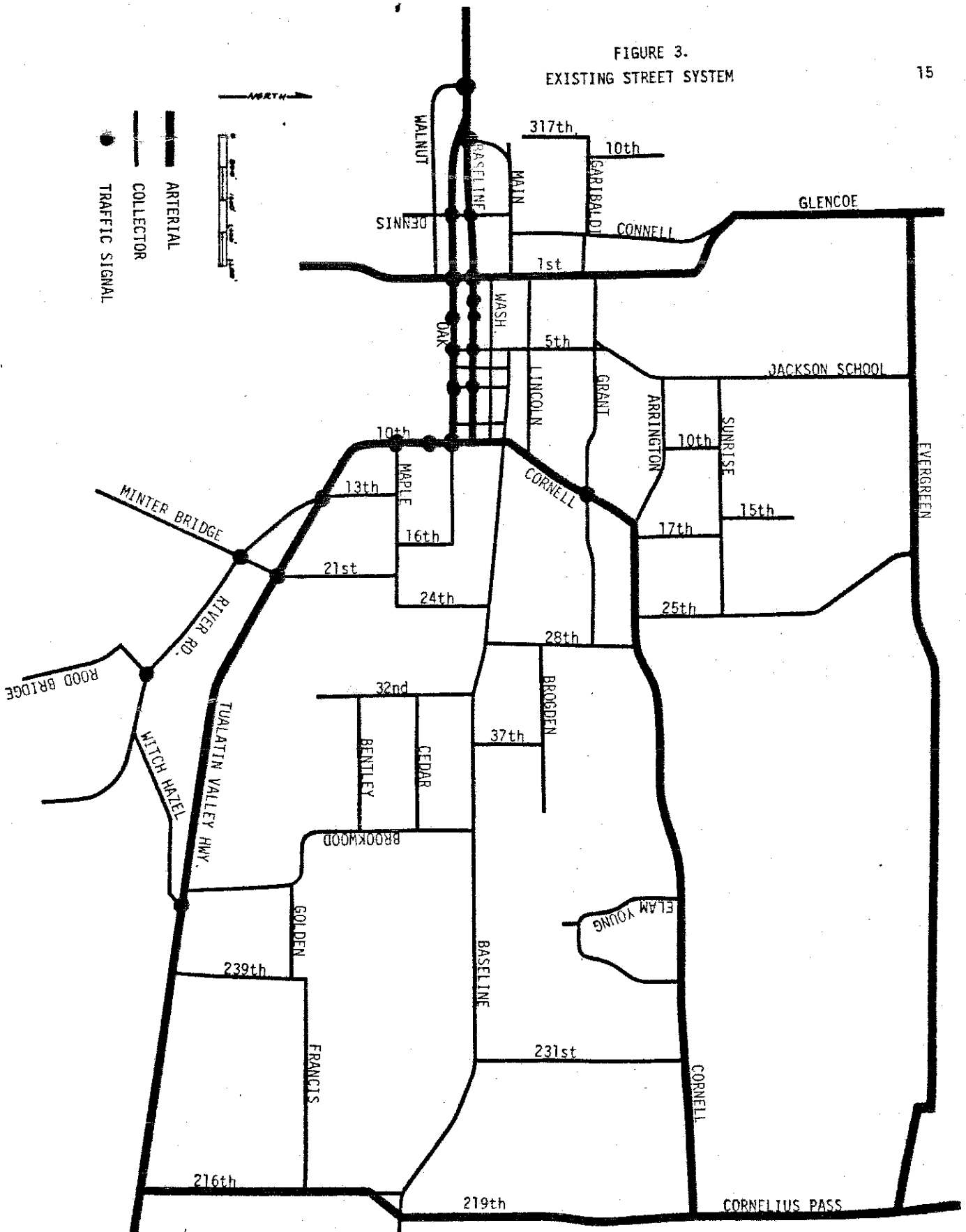
### Existing Streets

An inventory of the major streets (collector and arterial) was made by the City. This inventory indicates the roadway pavement condition, pavement width, number of travel lanes and the right-of-way width and the location of all traffic signals and stop signs. The existing street inventory is summarized on Figure 3 and indicates the number of travel lanes and location of all traffic signals on the City's collector and arterial streets.

Generally, all streets within the planning area are two lanes (some with left turn lanes) except for the following:

- Tualatin Valley Highway - four lanes plus left turn lanes east of 21st Avenue.
- 10th Avenue - four lanes south of Baseline Street
- Oak Street - three lanes eastbound from Dennis to 10th
- Baseline Street - three lanes westbound from 10th to a point near Dennis
- 1st Avenue - four lanes between Walnut and Lincoln Streets

FIGURE 3.  
EXISTING STREET SYSTEM



## Functional Street Classification

The following lists the functional classification of urban roadways and defines each:

Freeway - The highest form of roadway design. This type of facility is intended to provide for the expeditious movement of large volumes of traffic between, across, around or through a city, region or state.

The freeway is a divided highway with full control of access. It is not intended to provide access to abutting land. Complete separation of conflicting traffic movements is provided. Traffic volumes generally are higher than 30,000 vehicles per weekday.

Expressway - An expressway is intended to serve the same function as a freeway in areas where higher capacity and costly freeway design are not feasible. The expressway is a divided roadway with access provided only at signalized intersections or interchanges. It differs from a freeway in that it may have few or no grade separations. Because of this lack of grade separation, the expressway generally has more access points and thus is more useful for shorter trips than the freeway. Traffic volumes generally range between 20,000 to 40,000 vehicles per weekday.

Arterial Street - The primary function of an arterial street is to provide for the traffic movement between areas and across portions of a city or region, direct service to principal generators and connect to the freeway-expressway system. A subordinate function is the provision of direct access to abutting land. Since the primary function of this type street is movement of vehicles rather than access to abutting land or temporary storage of vehicles, arterial streets are subject to regulation and control of parking, turning movements, entrances, exits and curb uses. Control of access may also be required. Traffic volumes generally range between 5000 and 35,000 vehicles per weekday.

Collector Street - Functions to conduct traffic between arterial streets, activity centers and neighborhoods. It is a principal traffic carrier within a neighborhood and also provides some direct access to abutting land. The average weekday volume could range between 2,000 to 8,000 vehicles per day.

Local Street - Provides access to abutting land. These streets serve local traffic movements and are not intended to accommodate through traffic. The traffic volumes would be less than 1,200 vehicles per weekday in residential areas.

Cul-de-Sac Street - Functions as a local street providing access to abutting land. It is not a through street and contains a turn-around. Its volume should be less than 200 vehicles per weekday in residential areas.

There are no freeways or expressways within the planning area. However, Sunset Highway (U.S. 26) north of the planning area is constructed as an expressway.

As shown on Figure 3, the arterial streets within the planning area include the following:

- Tualatin Valley Highway
- 10th Avenue
- Baseline Street
- Oak Street
- Cornell Road
- 1st Avenue
- Evergreen Street

Jackson Road, Shute Road and Cornelius Pass Road north of the City function as arterial roadways.

Main Street - Baseline Road are currently classified as collector streets but actually function as arterials.

River Road is also classified as a collector street but because it connects to other cities and arterial roadways to the southeast, it functions as an arterial.

All other streets shown on Figure 3 are classified and function as collector streets.

#### Truck Routes

The City currently has a truck route system for commercial or heavy duty vehicles. These routes follow the currently classified arterials except for 1st Avenue. Trucks can operate on other streets only if they have an origin or destination on those streets, such as delivery vehicles.

#### Traffic Control Devices

Traffic is controlled primarily by traffic signals and stop signs. As shown on Figure 3, there are 24 traffic signals

located within the planning area. These signals are located primarily on the state highway system with the exception of downtown, Cornell Road and Grant Street and along River Road.

#### STREET CAPACITY

Transportation engineers have established various standards for measuring traffic capacity of a roadway or intersection.<sup>1</sup> Each standard is associated with a particular level of service one wishes to provide. The level-of-service concept requires consideration of factors which include travel speed, safety, frequency of interruptions in traffic flow, relative freedom for traffic maneuvers, driving comfort and convenience and operating cost. Six standards have been established ranging from level "A" where traffic flow is relatively free to level "F" where the street system is totally saturated or jammed with traffic. A description of each service level is provided on the following page.

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<sup>1</sup>Highway Capacity Manual 1965, Highway Research Board Special Report 87, National Academy of Science, National Research Council.

## SERVICE LEVELS FOR ARTERIAL ROADWAYS

|   | Typical Traffic Flow Conditions   |
|---|---|
| Service Level A   | Relatively free flow of traffic with some stops at signalized or stop sign controlled intersections. Average speeds would be at least 30 miles per hour. The volume to capacity ratio would be equal or less than 0.60.   |
| Service Level B   | Stable traffic flow with slight delays at signalized or stop sign controlled intersections. Average speed would vary between 25 and 30 miles per hour. The volume to capacity ratio would be equal or less than 0.70.   |
| Service Level C   | Stable traffic flow but with delays at signalized or stop sign controlled intersections to be greater than at level B but yet acceptable to the motorist. The average speeds would vary between 20 and 25 miles per hour. The volume to capacity ratio would be equal to or less than 0.80.   |
| Service Level D   | Traffic flow would approach unstable operating conditions. Delays at signalized or stop sign controlled intersections would be tolerable and could include waiting through several signal cycles for some motorists. The average speeds would vary between 15 and 20 miles per hour. The volume to capacity ratio would equal or be less than 0.90. |
| Service Level E   | Traffic flow would be unstable with congestion and intolerable delays to motorists. The average speed would be approximately 15 miles per hour. The volume to capacity ratio would be 1.00.   |
| Service Level F   | Traffic flow would be forced and jammed with stop and go operating conditions and intolerable delays. The average speed would be less than 15 miles per hour.   |
| <p>Note: The average speeds are approximations observed at the various levels of service but could differ depending on actual conditions.</p> |   |

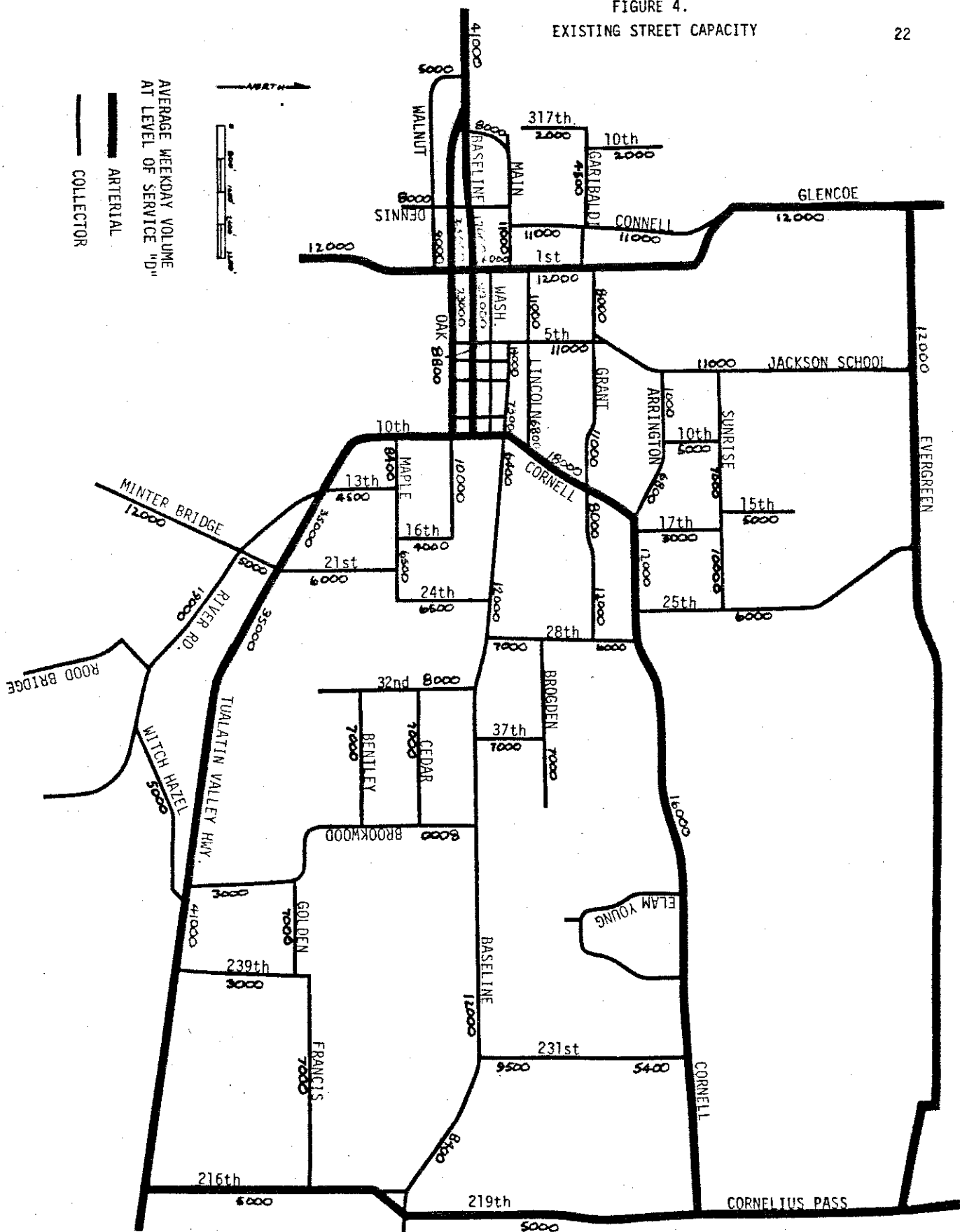
For this analysis, level of service "D" was utilized as a measure of capacity. This standard can be described as traffic conditions which include delays to vehicles for short periods of time within the peak period. However, enough traffic signal cycles of lower demand occur under these conditions to permit periodic clearance of developing queues to prevent excessive backups. Therefore, some motorists may experience delays which include waiting through several signal cycles during the peak periods before passing through the intersection, but most motorists would pass through the intersection without waiting through more than one cycle.

The capacity of each street was calculated on the basis of level of service "D" and is shown for a 24-hour basis on Figure 4.

Several streets are currently experiencing conditions when the peak period traffic flows equal or exceed the capacity of the streets. These include Tenth Avenue south of Oak Street, Main Street in the vicinity of Tenth Avenue and Cornell Road between Arrington Road and immediately east of Hillsboro Airport.

Congestion during short periods of time may occur throughout the day because of conflicts with left turning vehicles or parking on major streets. Some of these areas include Main

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Street east of First Avenue and First Avenue between Oak and Baseline Streets. These are operational problems which require solutions but do not necessarily indicate a capacity deficiency.

#### MOTOR VEHICLE ACCIDENTS

The Hillsboro Police Department provided accident data for the first nine months of 1978 at the highest accident locations during that time period. These locations are:

|                                | <u>Number of<br/>Accidents</u> |
|--------------------------------|--------------------------------|
| 10th Ave. & Maple St.          | 17                             |
| 10th Ave. & Walnut St.         | 16                             |
| 1st Ave. & Oak St.             | 13                             |
| Baseline St. & W. Main         | 11                             |
| Cornell Rd. & Grant St.        | 10                             |
| T. V. Hwy. & River Road        | 9                              |
| Cornell Rd. & 28th Ave.        | 9                              |
| Baseline St. & 9th Ave.        | 8                              |
| Cornell Rd. & Airport Entrance | 8                              |

Collision diagrams for each of these locations are included in the Appendix and indicate the type of accidents which have occurred.

Many of the accidents which have occurred on 10th Avenue at the intersections of Maple and Walnut Streets are attributable to the lack of left turn lanes.

At 1st Avenue and Oak Street, many of the accidents involve left turning vehicles colliding with through vehicles. A separation of these movements through traffic signal control would resolve much of this problem.

The accident pattern at the intersection of Baseline Street and West Main is not well defined. There appears to be a problem with motorists entering the intersection either too early or too late. Therefore, a short all red signal interval to clear the intersection before the next green indication would help to reduce the number of right angle accidents.

At Cornell Road and Grant Street, an all red signal interval may reduce the number of right angle accidents.

The accident pattern on T. V. Highway at River Road indicates that most motorists cannot stop in time and collide with a vehicle in front of them. The amber interval may need to be lengthened in time or the speed on T. V. Hwy. reduced.

The accidents occurring at the intersections of Cornell Road at 28th Avenue and at the Airport are attributable to

the lack of a left turn lane and more positive traffic control.

The pattern of accidents at Baseline Street and 9th Avenue is too varied to indicate a corrective solution. However, these accidents are somewhat indicative of the lack of available gaps in the Baseline traffic flow for motorists on 9th Avenue to cross Baseline Street. The installation of a traffic signal would reduce some of these accidents.

#### PUBLIC TRANSPORTATION

TRI-MET provides public transportation service within the City and to other points in the Region. It is currently developing plans for increased service over the next 20 years.

##### Current Service

Service is currently provided by two TRI-MET lines. The No. 57 - Forest Grove Line, operates between downtown Portland and downtown Forest Grove and the No. 68 - NE Hillsboro-Tanasborne Line operates between downtown Hillsboro and the Tanasborne Town Center.

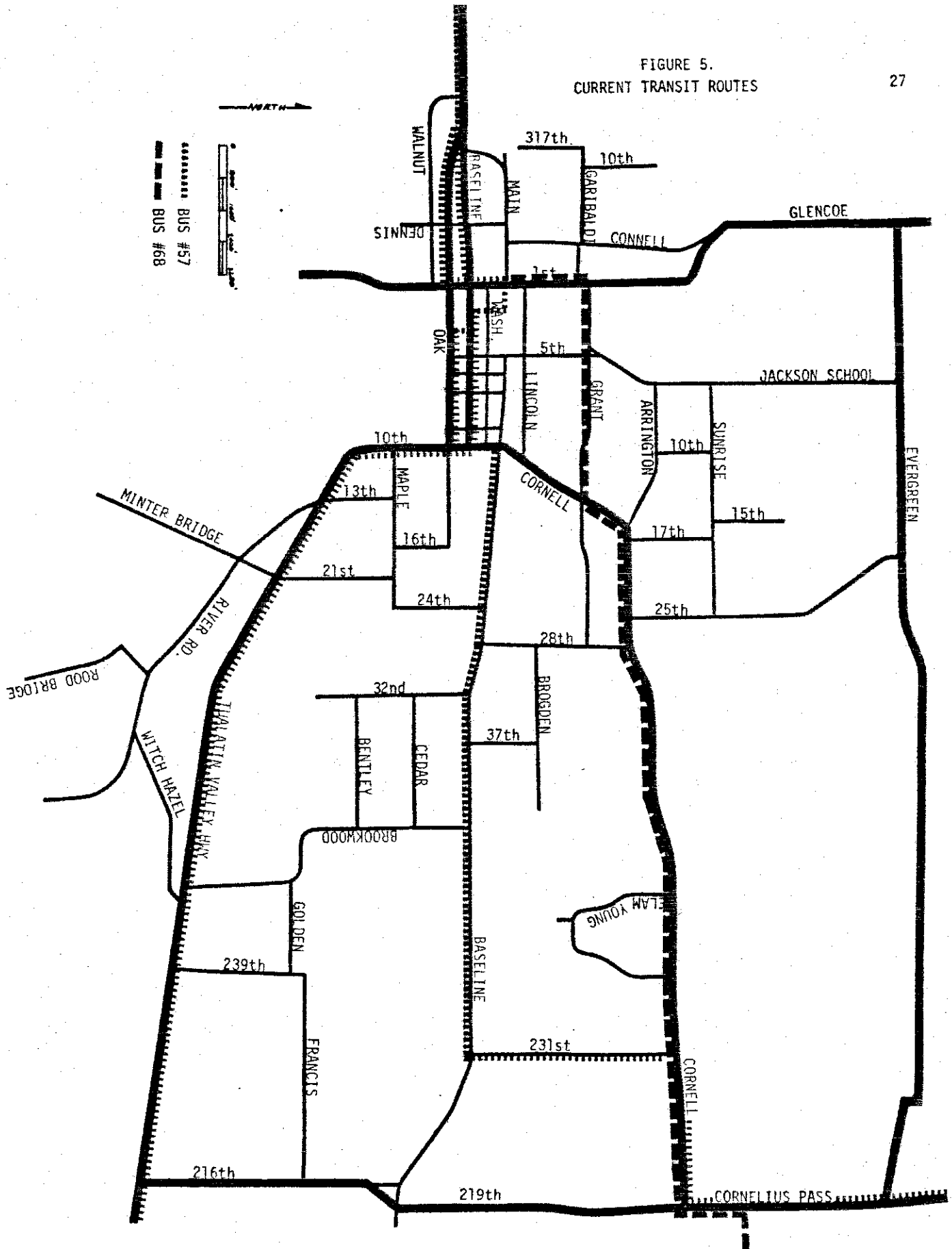
As indicated on Figure 5, both bus lines meet at a transfer point at Second Avenue and Washington Street. These lines are scheduled and routed to be an integral part of the Westside Bus Service initiated in June 1979. These lines meet at other transfer stations at the Tanasborne Town Center and the Beaverton Transit Station. At these stations, one can transfer to other lines serving Washington County.

#### Future Service

TRI-MET and the Metropolitan Service District (MSD) are developing future service plans for the west side. These include a major east-west transit corridor to Portland consisting of either light rail transit or an express bus system with some exclusive bus facilities. Various corridors have been identified for further analysis. Between Portland and Beaverton the corridors being analyzed are Sunset Highway-217 and the Multnomah Boulevard Corridor. Between Beaverton and Hillsboro, the Burlington Northern and the Southern Pacific (or T. V. Highway) corridors are being analyzed.

MSD has indicated that it will choose the corridor and vehicle type during the fall of 1980. It is planned that this improved service would be in operation at least

FIGURE 5.  
CURRENT TRANSIT ROUTES



to Beaverton by 1988. The implementation of this type of service, whether it be light rail or express bus, will include major transfer stations and park-and-ride stations as well as local bus service serving transfer stations. Therefore, service in Hillsboro is expected to continue to increase over the next 20 years with the possibility of light rail or express bus service with transfer stations and increased local service after 1990.

#### TRAVEL CHARACTERISTICS

The current travel characteristics of people living and working in Hillsboro were surveyed by the City during 1978. The City<sup>1</sup> conducted 657 home interviews to obtain current household characteristics. The City<sup>2</sup> also interviewed 156 of 562 known businesses in Hillsboro to determine business and employee characteristics. In each of these surveys, questions relating to travel characteristics were asked.

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<sup>1</sup>Hillsboro Comprehensive Plan, Residential Survey, City of Hillsboro Planning Department, 1978.

<sup>2</sup>Hillsboro Business Survey, City of Hillsboro Planning Department, 1978.

### Household Characteristics

Household characteristics which relate to travel habits were obtained from the interviews and are summarized on Table 3. The average household size was found to be 3.05 people per dwelling with an average household income of \$18,170. The average vehicle ownership is 1.72 vehicles per household. Each household on the average has 1.09 persons employed.

### Location of Residence and Employment

The employees surveyed were asked where they live and the residents were asked where they work. Table 4 is a summary of where people live and work.

As indicated on Table 4, 43 percent of the people working in Hillsboro live in Hillsboro. Therefore, 57 percent of the jobs are held by people living outside the City and commuting to Hillsboro from the areas shown on Table 4. It is also indicated that 37 percent of the Hillsboro work force (workers living in Hillsboro) have jobs in Hillsboro and 63 percent of the people commute to other cities to work.

TABLE 3

## HOUSEHOLD CHARACTERISTICS

|                           |               |
|---------------------------|---------------|
| Average Household Size    | 3.05 persons  |
| Average Annual Income     | \$18,170      |
| Average Vehicle Ownership | 1.72 vehicles |
| Average Number of Workers | 1.09 persons  |

Source: City of Hillsboro Planning Department  
Residential Survey 1978

TABLE 4

## LOCATION OF WHERE PEOPLE LIVE AND WORK

|              | Location of<br>Residence for<br>People Working<br>in Hillsboro | Location of<br>Work for<br>People Living<br>in Hillsboro |
|--------------|--|--|
| Hillsboro    | 43.2%  | 37.1%  |
| Beaverton    | 17.7   | 28.5   |
| Cornelius    | 6.7  | 2.6  |
| Forest Grove | 11.8   | 2.4  |
| Portland     | 11.0   | 18.1   |
| Tigard Area  | 3.0  | 5.1  |
| Other        | 6.6  | 6.2  |
| Total        | 100.0  | 100.0  |

Source: City of Hillsboro Planning Department  
Residential and Business Surveys 1978  
and Carl H. Buttke, Inc.

### Mode of Travel to Work

The surveys indicated that approximately 87 percent of the people working in Hillsboro drove to work and slightly over one percent used public transportation. (See Table 5.) The average vehicle occupancy was 1.06 people per vehicle for workers in Hillsboro.

At the residential side, 93 percent of the residents of Hillsboro drove to work with an average vehicle occupancy of 1.04 people per vehicle. Approximately one percent of the residents used public transportation to work.

### Employee Work Hours

The times people arrive and leave their jobs in Hillsboro are shown on Table 6. The early work hours are indicative of the industrial jobs in the City. Approximately 45 percent of the people arrive at work during the A.M. peak hour (7:30 to 8:30 a.m.) and 47 percent leave during the P.M. peak hour (4:30 to 5:30 p.m.). It appears that staggered work hours or flex time could reduce the peak hour traffic volumes.

TABLE 5

## MODE OF TRAVEL TO WORK

| Mode   | Employees<br>in Hillsboro | Residents<br>of Hillsboro |
|--|---------------------------|---------------------------|
| Drive Vehicle  | 87.3%                     | 93                        |
| Passenger  | 5.0                       | 4                         |
| Bus  | 1.4                       | 1                         |
| Walk   | 2.9                       | 2                         |
| Other  | 3.4                       | -                         |
| Total  | 100.0                     | 100                       |
| <p>Source: City of Hillsboro Planning Department<br/>Residential and Business Surveys 1978</p> |                           |                           |

TABLE 6

## TIME EMPLOYEES ARRIVE AND LEAVE WORK IN HILLSBORO

|   | Percent<br>Arrivals | Percent<br>Departures |
|---|---------------------|-----------------------|
| 6:30 - 7:00 am  | 13.9%               |                       |
| 7:00 - 7:30   | 7.2                 |                       |
| 7:30 - 8:00   | 17.8                |                       |
| 8:00 - 8:30   | 27.8                |                       |
| 8:30 - 9:00   | 10.3                |                       |
| 9:00 - 9:30   | 2.6                 |                       |
| 3:00 - 3:30 pm  |                     | 2.4%                  |
| 3:30 - 4:00   |                     | 11.6                  |
| 4:00 - 4:30   |                     | 2.5                   |
| 4:30 - 5:00   |                     | 12.4                  |
| 5:00 - 5:30   |                     | 34.3                  |
| 5:30 - 6:00   |                     | 7.6                   |
| Other   | 20.4                | 29.2                  |
| Source: City of Hillsboro Planning Department<br>Business Survey 1978 |                     |                       |

## TRAVEL FORECASTS

The future traffic pattern in and through the City was defined by estimating the future traffic which would be generated by the existing and future building developments within and around the City, by distributing these trips to destinations through the planning area and to points outside the area and then by assigning these trips to the street system. Traffic estimated to pass through the City was added to the assignment.

The City and surrounding area were divided into 39 traffic analysis zones for the process of defining the existing and future land use, estimating trip generation, distributing and assigning vehicle trips. A copy of the zone map is shown on Figure A-2 in the Appendix.

## TRIP GENERATION

Vehicle trip generation estimates were made for each traffic analysis zone in the planning area on the basis of the type and quantity of land use inventoried and forecast. Vehicle trip generation rates were developed for each type of

building or land use from measurements made in Hillsboro, other cities in Oregon and from measurements made at similar buildings and land uses throughout the United States.<sup>1</sup>

The generation rates developed for home connected trips also utilized the data collected by the city home interviews as previously described and data collected by MSD from its recent home interviews conducted throughout the region. Data from MSD related trips to household size, average income and vehicle ownership. The Hillsboro home interviews provided average household size, income and vehicle ownership from which trip rates were then calculated. The vehicle trip rates calculated for 1978 are shown on Table 7 by general building type and represent a two-way 24-hour volume rate.

In some locations, such as the downtown area, the vehicle trip generation was reduced by as much as 50 percent to account for the large number of people walking between buildings without driving a vehicle.

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<sup>1</sup>Institute of Transportation Engineers, "An Information Report, Trip Generation," 1976; and unpublished trip generation analyses by Carl H. Buttke, Inc., Consulting Transportation Engineer.

TABLE 7

## VEHICLE TRIP GENERATION RATES

City of Hillsboro

|                           | Average Weekday Two-Way Vehicle<br>Trip Rates |                 |
|---------------------------|---|-----------------|
| Land Use/Building Type    | 1978  | 2000            |
| Single Family Residential | 10.4 per D.U.                                 | 9.8 per D.U.    |
| Multi Family Residential  | 7.0 per D.U.                                  | 6.2 per D.U.    |
| Mobile Homes              | 7.3 per D.U.                                  | 6.4 per D.U.    |
| General Office            | 12.5 per T.S.F.                               | 10.3 per T.S.F. |
| Medical Office            | 55.0 per T.S.F.                               | 51.4 per T.S.F. |
| Retail                    | 50.0 per T.S.F.                               | 44.9 per T.S.F. |
| Industrial                | 51.0 per A.                                   | 41.4 per A.     |
| Warehouse                 | 23.4 per A.                                   | 20.2 per A.     |

Note: T.S.F. = Thousand square feet of gross building area

D.U. = Dwelling Unit

A. = Acre

Specific buildings may have different rates because of proximity to other buildings.

The vehicle trip generation rates utilized for the year 2000 projections were modified from the 1978 rates to include the effect of increased transit service and ridership and the effect of increased carpooling. Projections made by MSD indicate that by the year 2000 approximately eight percent of the home to work trips generated in the Hillsboro area would use public transportation, as compared to one percent in 1978. The MSD estimate assumes very little change in transit improvements. For purposes of this analysis, it was assumed that a slightly better level of transit service would be provided and therefore would result in approximately ten percent of the workers using public transportation by the year 2000.

It is also assumed that the average vehicle occupancy for home to work trips will increase by approximately 15 percent from 1.04 to 1.20 persons per vehicle as a result of carpool programs, vehicle operating and parking costs and traffic congestion. The vehicle trip generation rates for the year 2000 analyses are also shown on Table 7. In some cases, these rates were modified to reflect special situations, such as in the downtown area where more people are likely to walk to buildings while having driven and parked at other buildings for other purposes.

The vehicular trips were estimated for three basic trip purposes: trips to and from work and connected to the

home; trips to and from shopping and connected to the home or other locations; and trips made for all other reasons. The trips were further categorized into trip productions--usually produced or generated at the home--and trip attractions--usually attracted to or generated at other land uses (such as places of employment or shopping). Table 8 summarizes the estimated 1978 and year 2000 vehicle trips produced and attracted within the planning area by basic trip purpose.

It is anticipated that the number of trips produced in the Hillsboro Planning Area will increase from approximately 95,000 vehicle trips per day in 1978 to 199,000 vehicle trips per day by the year 2000.

The attractions in the Hillsboro Planning Area are forecast to increase from 96,000 vehicle trips per day (two-way) in 1979 to 189,000 vehicle trips (two-way) in the next 20 years.

The assumed year 2000 land use and trip productions or attractions for each traffic analysis zone are included in Table A-1 in the Appendix.

TABLE 8

## ESTIMATED VEHICLE TRIP GENERATION FOR PLANNING AREA

Two-Way Average Weekday Driveway Volume

|                         | 1978   | 2000    |
|-------------------------|--------|---------|
| Trip Productions        |        |         |
| Home Connected Work     | 17,000 | 28,000  |
| Home Connected Shopping | 16,000 | 35,000  |
| Other                   | 62,000 | 136,000 |
| Total                   | 95,000 | 199,000 |
| Trip Attractions        |        |         |
| Home Connected Work     | 13,000 | 37,000  |
| Home Connected Shopping | 35,000 | 70,000  |
| Other                   | 48,000 | 82,000  |
| Total                   | 96,000 | 189,000 |

## TRIP DISTRIBUTION

The distribution of trip productions to the trip attractions within each traffic analysis zone and streets and highways leading into and out of Hillsboro was made separately for the three major trip purposes.

The City home interview data provided information indicating the percent of work and shopping trips which were made by each household to destinations within Hillsboro and to destinations throughout the region. These data were utilized for the testing procedure for 1978 trips.

The estimated year 2000 trips were distributed throughout the region on the basis of a trip distribution model developed by MSD for its planning analyses. The MSD model was developed by dividing the region into 80 districts and distributing trips among each of the 80 districts by trip purpose. The Hillsboro Planning Area was one of the 80 districts. Therefore, trips were distributed among the 39 traffic analysis zones within the Planning Area on the basis of the size of the attractors and to the rest of the region on the basis of the MSD trip distribution model results.

As indicated previously, 37 percent of the Hillsboro work force has jobs in the City whereas 63 percent of the work force commutes to other cities to work. By the year 2000,

it is estimated that 68 percent of the Hillsboro work force will have jobs in the City and only 32 percent will commute to other cities for work. This change in the commute pattern is expected because of the increase in employment estimated for the City and the increasing commute time and cost as roads become more congested over time.

Shopping trips were distributed for convenience type shopping trips which are normally made within about two miles of home and comparison type shopping trips which are normally made within 20 to 30 minutes drive of the home. It is estimated that approximately 87 percent of the shopping trips produced at the home in Hillsboro will stay in the City to shop and only 13 percent will drive to other cities by the year 2000.

#### VEHICLE TRIP ASSIGNMENT

The vehicle trip assignments to the street and highway system were made for 1978 to test and verify the methodology and for the year 2000. The assignments were made on the basis of the trip generation and distribution from all production zones and streets leading into the planning area to all attraction zones and streets leading out of the area

utilizing the shortest and most logical route. The estimated amount of traffic passing through the City was added to these assignments to represent the total traffic on the street system.

A comparison of the 1978 measured average weekday traffic and the assigned 1978 traffic was made at general locations around the City to test the reliability of the procedure. The first test indicated that traffic assigned to the major east-west streets within the City was within three percent of the measured volume but the assigned traffic entering and leaving the City was approximately 21 percent higher. Therefore, the trip distribution was modified by increasing the amount of traffic which would remain within the City and a correction was made to the trip generation in the downtown area. These modifications then provided a verification that the procedure realistically portrayed actual traffic conditions on the major streets in 1978 and that the forecasting technique could be utilized for testing the street system plans.

The assignment of year 2000 traffic was made to the system of streets and highways as they exist today including any committed modifications to these streets to determine how well the system will accommodate the forecast growth and where new facilities or modifications might be needed.

Figure 6 indicates the assignment of year 2000 average week-day traffic to the existing plus committed street system within the Planning Area.

As indicated on Figure 6, traffic on both Oak and Baseline Streets is expected to vary between 19,000 vehicles per day west of First Avenue and 23,000 vehicles per day west of Tenth Avenue.

Tenth Avenue is forecast to carry some 40,000 vehicles per day between Oak Street and T. V. Highway. North of Oak Street, the traffic on Tenth Avenue is estimated to vary between 28,000 and 30,000 vehicles per day.

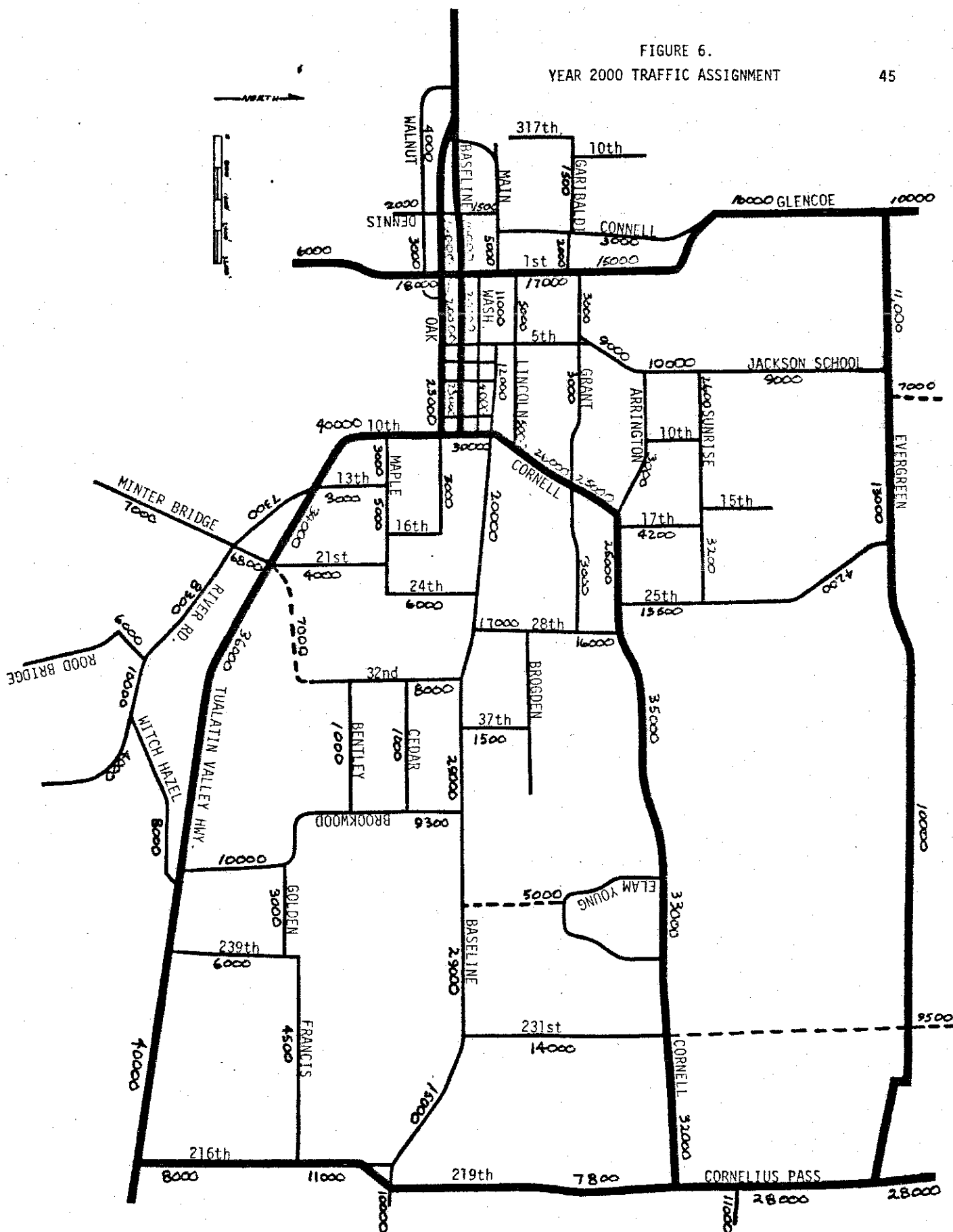
Traffic on T. V. Highway is forecast to vary between 34,000 and 40,000 vehicles per day east of Tenth Avenue.

Cornell Road is estimated to carry some 26,000 vehicles per day north of Main Street and 32,000 to 37,000 vehicles per day between 25th Avenue and Cornelius Pass Road. Cornelius Pass Road is forecast to carry approximately 28,000 vehicles per day between Cornell Road and the Sunset Highway.

Traffic on First Avenue is expected to vary between 15,000 and 19,000 vehicles per day between Walnut Street and Evergreen Road.

East Main Street is forecast to carry approximately 12,000 vehicles per day west of Tenth Avenue and 20,000 vehicles

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per day east of Tenth Avenue. Between 24th and 231st Avenues the volume is expected to vary between 28,000 and 29,000 vehicles per day. East of 231st Avenue, the traffic volume is anticipated to be approximately 15,000 vehicles per day.

It is estimated that Evergreen Road would function as a collector street west of Shute Road with an estimated volume of 10,000 to 13,000 vehicles per day.

Traffic on 5th Avenue and Jackson School Road, a north-south collector street system, is anticipated to vary between 9,000 and 10,000 vehicles per day.

Traffic on 28th Avenue between Main Street and Cornell Road is estimated at approximately 17,000 vehicles per day.

The results of this assignment indicate that many of the north-south traffic movements between Tenth Avenue and 216th Avenue are forced to travel east-west on Main Street and on Cornell Road thus adding to the east-west traffic flows.

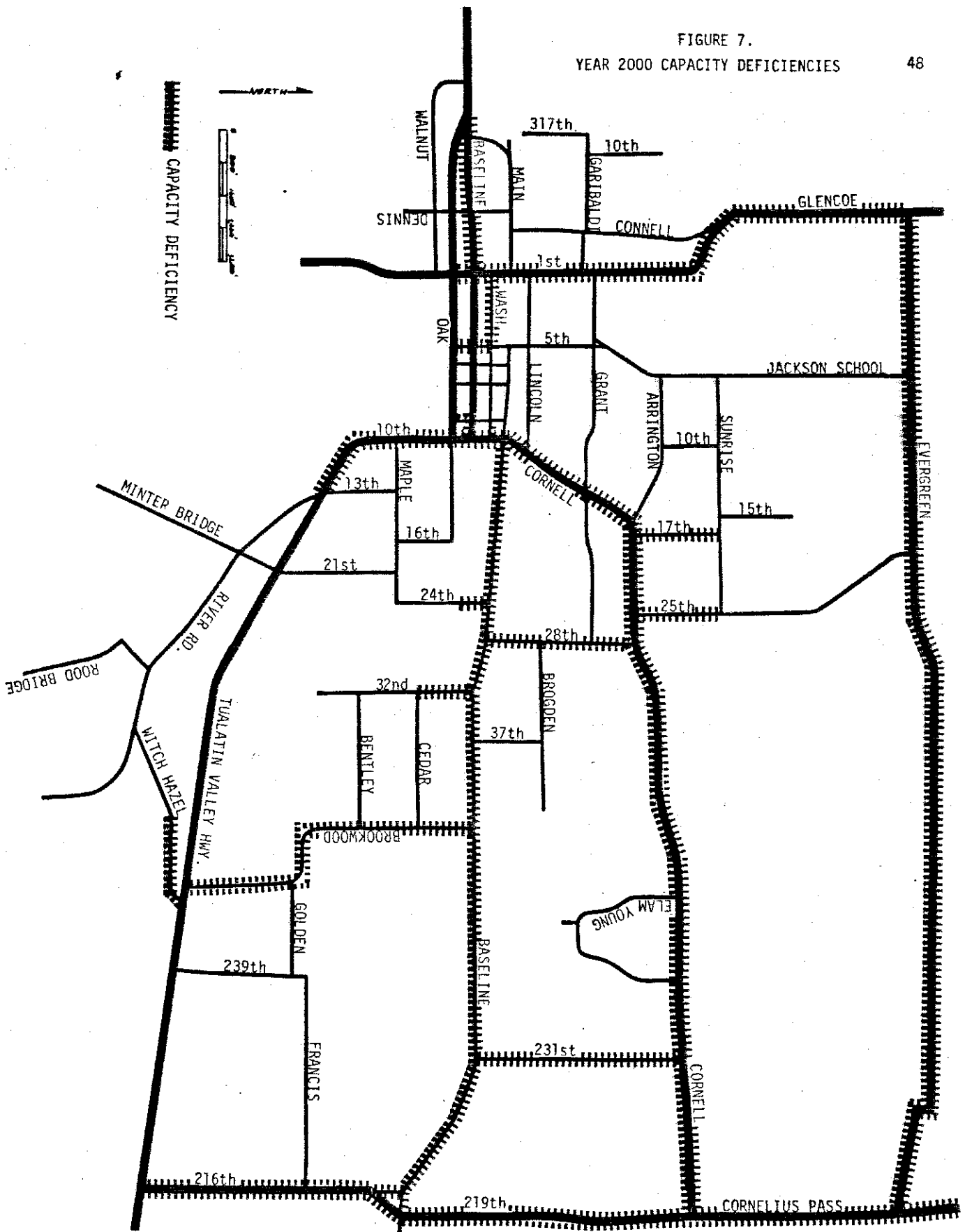
## EXISTING PLUS COMMITTED SYSTEM CAPACITY DEFICIENCIES

The assigned year 2000 traffic was compared to the capacity of the existing plus committed street system to determine where the system would be overloaded and to provide a basis for examining alternative changes to the system.

Street capacity of the existing streets as they exist today plus the committed improvements were calculated on the basis of service level D as previously described. Figure 7 indicates those streets forecast to operate at or lower than level of service D. These streets are as follows:

- Baseline Street west of 1st Avenue
- Tenth Avenue
- Cornell Road
- E. Main Street east of 10th Avenue
- Evergreen Road
- Witch Hazel Road south of T. V. Highway
- First Avenue and Glencoe Road
- Fifth Avenue between Oak and Washington Streets
- 17th Avenue north of Cornell Road
- 24th Avenue south of Main Street
- 25th Avenue north of Cornell Road
- 28th Avenue
- 32nd Avenue south of Main Street
- Brookwood Avenue

48



- 231st Avenue
- 216th-219th Avenues
- Cornelius Pass Road

It is anticipated that major capacity deficiencies will occur on the City's arterial streets and the major north-south collector streets. It is anticipated that these major capacity deficiencies, if not corrected or reduced, will contribute to more accidents at both the signalized and nonsignalized intersections and could discourage development in some sectors of the planning area.

It is concluded from these analyses that additional east-west street capacity and improved north-south circulation will be necessary to accommodate the future growth. It will also be necessary to initiate steps to manage the City's transportation system through development of staggered work hours and flex time programs, carpool and vanpool programs, increasing public transportation service to and within the City and other methods of reducing the vehicular trip demand such as improving the pedestrian and bikeway system.

## ALTERNATIVE IMPROVEMENTS

Alternative improvements or additions to the major street network were developed and tested with the goal of minimizing the capacity deficiencies on the street system, reducing accident potential, increasing vehicular circulation within the City, minimizing the scale of street improvements and the capital costs and satisfying the desires of the community. The network testing was accomplished by assigning the year 2000 traffic to each alternative to determine its impact on the street system. The capital cost of each alternative was developed for comparison purposes. The alternatives and results of the testing of each alternative were reviewed with City staff and the community at neighborhood workshops held at the beginning and end of this testing process.

## STREET SYSTEM ALTERNATIVES

### Widen Existing Streets

The first alternative is a concept of increasing street capacity by widening existing streets and not constructing new major roadways except for collector streets within developing subdivisions.

To accommodate the year 2000 assigned traffic volumes as shown on Figure 6 and solve the expected capacity deficiencies, widening of the following streets would be required:

1. Widen Baseline Street between Dennis Avenue and the intersection with T. V. Highway from the existing two lanes to three travel lanes for a cost of \$265,000.
2. Widen Tenth Avenue between Main Street and T. V. Highway to provide two travel lanes in each direction plus continuous left turn lanes in the median area. Install median in T. V. Highway east of Tenth Avenue. This total widening is estimated to cost \$870,000.
3. Widen Cornell Road to four travel lanes with left turn lanes at Grant Street and east of Arrington Road for a cost of \$3,100,000.
4. Widen E. Main Street to four travel lanes with continuous left turn lanes between Tenth and 216th Avenues for a cost of \$4,520,000.
5. Widen Evergreen Road to 40 feet to provide two travel lanes and left turn lanes between Glencoe and Shute Roads for a cost of \$2,900,000.
6. Widen Witch Hazel Road south of T. V. Highway to provide two travel lanes with left turn lanes for a cost of \$670,000.

7. Widen First Avenue and Glencoe Road between Lincoln Street and Evergreen Road and between Walnut Street and Wood Street to provide two travel lanes in each direction plus continuous left turn lanes for a cost of \$1,800,000.
8. Add a continuous left turn lane in Fifth Avenue between Oak and Washington Streets by removing curb parking and re-striping the roadway.
9. Widen 17th Avenue between Cornell Road and Sunrise Lane to provide two travel lanes plus a left turn lane at Cornell Road for a cost of \$265,000.
10. Widen 24th Avenue to two travel lanes with left turn lanes south of Main Street. This widening would also include 21st Avenue north of T. V. Highway and Maple Street between 21st and 24th Avenues because of the poor condition of those roadways. This project is estimated to cost \$580,000.
11. Widen 25th Avenue north of Cornell Road to two travel lanes and left turn lanes at key intersections and driveways for a cost of \$1,000,000.
12. Widen 28th Avenue between Cornell Road and Main Street to two travel lanes with left turn lanes at key intersections for a cost of \$560,000.

13. Widen 32nd Avenue south of Main Street to two travel lanes with left turn lanes at key intersections for a cost of \$470,000.
14. Widen Brookwood Road between T. V. Highway and Main Street to provide two travel lanes and left turn lanes at key intersections for a cost of \$1,000,000.
15. Widen 231st Avenue between Main Street and Cornell Road to provide two travel lanes with left turn lanes at key intersections for a cost of \$750,000.
16. Widen 216th and 219th Avenues between Cornell Road and T. V. Highway to provide two travel lanes with left turn lanes at key intersections for a cost of \$2,600,000.
17. Widen Cornelius Pass Road to four travel lanes with left turn lanes at key locations between Cornell Road and Sunset Highway for a cost of \$1,300,000.

These 17 major street widening projects are estimated to cost a total of \$22,650,000. However, in addition to these projects, numerous smaller street paving projects would be necessary because of the roadway and drainage conditions and to complete missing links in a section of roadway.

This concept of widening the capacity deficient streets is expected to satisfy the year 2000 traffic volumes but it will not provide improved north-south circulation throughout

the City. Consequently, some east-west roadways would have to be widened by an extra lane to accommodate the inefficient circulation. The most notable example is East Main Street east of Tenth Avenue. This widening to four travel lanes with left turn lanes will be extremely difficult to achieve because of the additional right-of-way required and the adverse impact on the existing residences along Main Street. Citizen reactions at the neighborhood workshops generally were in opposition to widening E. Main Street beyond two lanes with left turn lanes because of the impact on the residences and the additional right-of-way which would be required from the front yards of the homes.

Alternatives to these street widenings were developed to improve north-south and cross-town circulation with the hopes of minimizing street widening projects.

#### South Bypass

The South Bypass is an alternative to relieve traffic flows on Oak and Baseline Streets through the center of the City and to relieve Tenth Avenue. This would be achieved by providing a convenient route for through traffic to bypass the most congested part of the City.

This concept as suggested by the City over the past years is shown on Figure 8 together with an assignment of year 2000 average weekday traffic. It is anticipated that it would divert approximately 11,000 vehicles per day from Oak and Baseline Streets west of First Avenue. East of First Avenue, it is expected to divert approximately 15,000 vehicles per day from Oak, Baseline, Washington and Main Streets and from Tenth Avenue south of the Oak-Baseline Street couplet. Traffic on First Avenue would be reduced slightly between Main and Baseline Streets and would be increased south of Baseline Street as indicated on Figure 8.

This bypass would have a positive effect of reducing the traffic on the streets in the central part of the City. The greatest impact is expected to occur on Tenth Avenue south of Baseline Street where the year 2000 traffic would be slightly lower than the volume in 1978.

However, a left turn lane would still be required in Tenth Avenue to accommodate that volume of traffic and Baseline Street west of Dennis Avenue should be widened to provide a uniform street section with three westbound lanes. Therefore, the South Bypass, while reducing traffic in the central part of the City, does not reduce the street widening requirement there.

The location of the bypass as suggested in the past would be difficult to achieve because of existing developments.

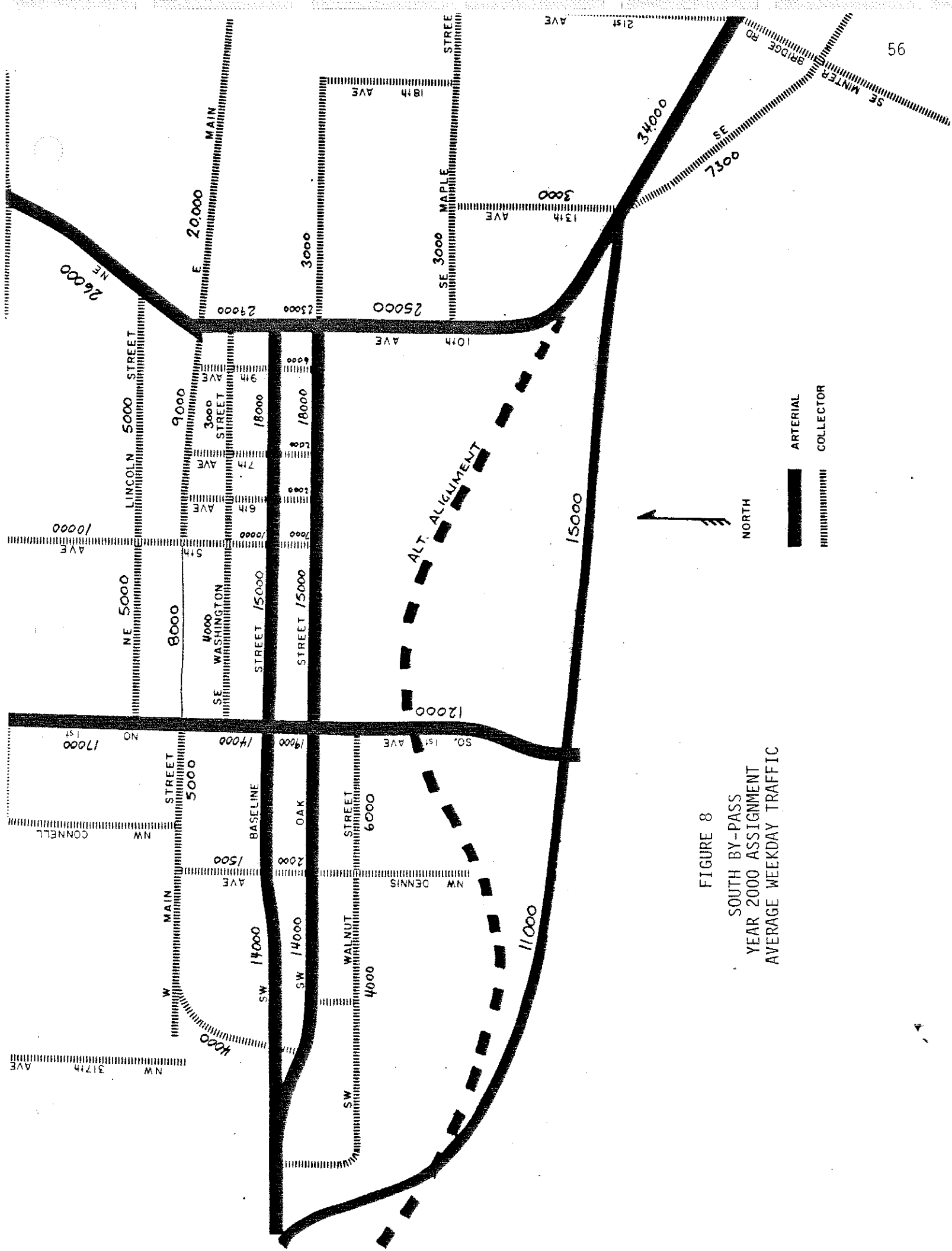


FIGURE 8  
SOUTH BY-PASS  
YEAR 2000 ASSIGNMENT  
AVERAGE WEEKDAY TRAFFIC

However, an alternative, as shown on Figure 8, would utilize the Southern Pacific Company right-of-way. In the event that the Southern Pacific Company abandons this right-of-way, it is advised that the City acquire it for a potential South Bypass. It is estimated that the South Bypass as a 40 foot, two-lane roadway with left turns would cost approximately \$2,000,000 to construct.

#### Ninth-Tenth Avenue Couplet

An alternative to widening Tenth Avenue to provide four travel lanes plus continuous left turn lanes between Main Street and T. V. Highway would be to convert Ninth and Tenth Avenues into a one-way couplet system.

Tenth Avenue would be converted into a one-way northbound roadway between Cedar and Main Streets. Three northbound travel lanes could be provided between Cedar and Baseline Streets and two northbound lanes north of Baseline Street. Curb parking could also be provided along one side of the street between Cedar and Oak Streets and north of Baseline Street.

Ninth Avenue would be converted from a two-way street to one-way southbound with two travel lanes and curb parking on one side of the street.

The implementation of this couplet system would also require Main Street to be one-way westbound and Washington Street to be one-way eastbound. It would also be necessary to modify the intersections between Ninth and Oak Streets, Ninth and Cedar Streets and Tenth and Cedar Streets to provide a larger radius for turning vehicles.

Tenth Avenue would also require widening south of Cedar Street to accommodate left turn lanes at Maple Street. The widening of Tenth Avenue and modification of the intersection with Cedar Street would require the relocation of the City tennis courts.

It is estimated that this couplet and the required traffic signals would cost approximately \$700,000 to install.

Figure 9 indicates the assignment of year 2000 traffic to the couplet system. The result of this couplet would be to spread the traffic load to both Ninth and Tenth Avenues and thereby reduce congestion and increase local access to businesses on Tenth Avenue. Traffic operations would be improved by this couplet, especially in the vicinity of Tenth and Baseline Streets as compared to a two-way operation.

The major disadvantage of this couplet would be the increased traffic load on Ninth Avenue which is a residential street today. However, the Comprehensive Plan indicates that most of Ninth Avenue would be in commercial use. The second



disadvantage is that the couplet costs approximately \$190,000 more than widening Tenth Avenue between Main Street and T. V. Highway because of the additional traffic signals required on Ninth Avenue.

From a traffic engineering standpoint, it is concluded that the Ninth-Tenth Avenue one-way couplet would function better than a widened two-way Tenth Avenue and would therefore result in less congestion.

#### Main-Washington Street Couplet

This alternative would consist of converting E. Main Street from a two-way street to a one-way westbound street east of approximately 18th Avenue to 6th Avenue where it presently is one-way westbound.

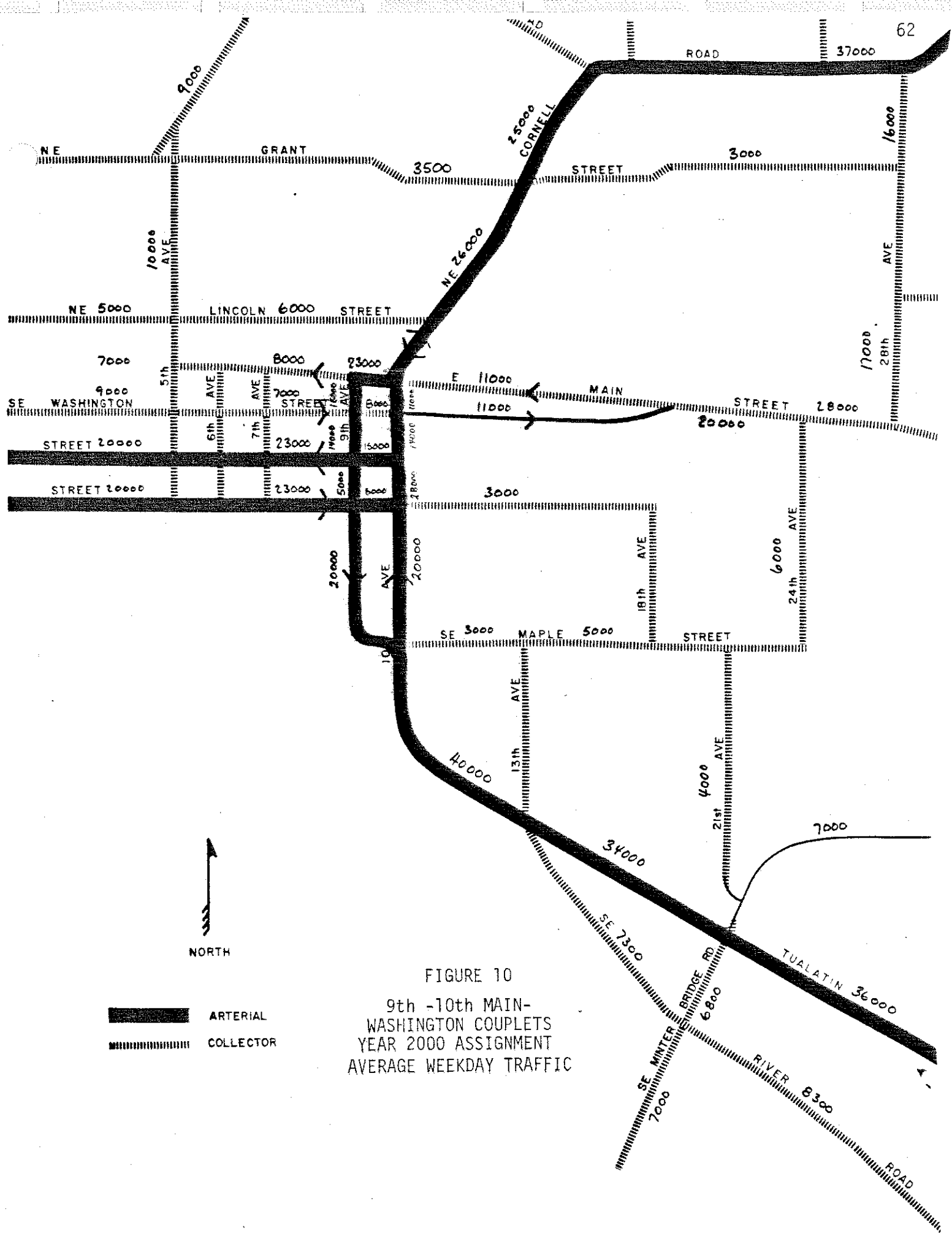
Washington Street which is one-way eastbound between First and Fifth Avenues would be extended to approximately 18th and Main Street. The existing two-way section of Washington Street between Fifth and 12th Avenues would be converted to one-way eastbound. A new section of Washington Street would be constructed east of 12th Avenue along the abandoned Burlington-Northern Railroad right-of-way to intersect with Main Street at about 18th Avenue. Main Street east of this one-way couplet would remain as a two-way roadway.

The purpose of the Main-Washington Street couplet would be to distribute traffic more uniformly between the two streets, to increase street capacity and thereby reduce traffic congestion and to reduce the amount of street widening on Main Street east of Tenth Avenue.

It is estimated that the cost to install this couplet would be approximately \$415,000 and would include a noise and sight berm along the newly constructed section of Washington Street. It is also estimated that this couplet system would reduce the need of widening Main Street between 10th and 18th Avenues from a 64 foot to a 40 foot roadway. Therefore, a savings of approximately \$90,000 of construction work would result on Main Street as well as a reduction of impact on the abutting homes.

Figure 10 indicates the assignment of year 2000 traffic to the Main-Washington Street couplet and the resulting effect of balancing traffic flows on Main and Washington Streets.

It is concluded that the Main-Washington Street couplet between First and 18th Avenues would provide for improved traffic operations in the central part of the City, especially if the Ninth and Tenth Avenue couplet were also implemented.



### Washington Street Extension

An alternative shown on Figure 11 was developed to reduce the traffic demand on Cornell Road, especially in the area south of Arrington Road. This alternative consists of extending Washington Street easterly on the abandoned Burlington Northern Railroad right-of-way from Main Street to 28th Avenue. It is estimated that this extension which would include noise berms, a pedestrian overpass and consist of only a two-lane roadway would cost approximately \$525,000 to construct.

As indicated on Figure 11, the traffic impact on Cornell Road is estimated to be minimal and therefore could not be justified.

A second alternative to the use of the Burlington Northern Railroad right-of-way was developed by extending the roadway easterly to approximately 34th Avenue and then connecting to Cornell Road. This alternative also included a realignment and connection between 25th and 28th Avenues at Cornell Road as shown on Figure 12.

This alternative would consist of a 28 foot roadway between 18th Avenue and Main Street and approximately 34th Avenue and Cornell Road with widenings to 36 feet at the major intersections for left turn lanes. A pedestrian overpass and noise berms would be included. It is estimated that the

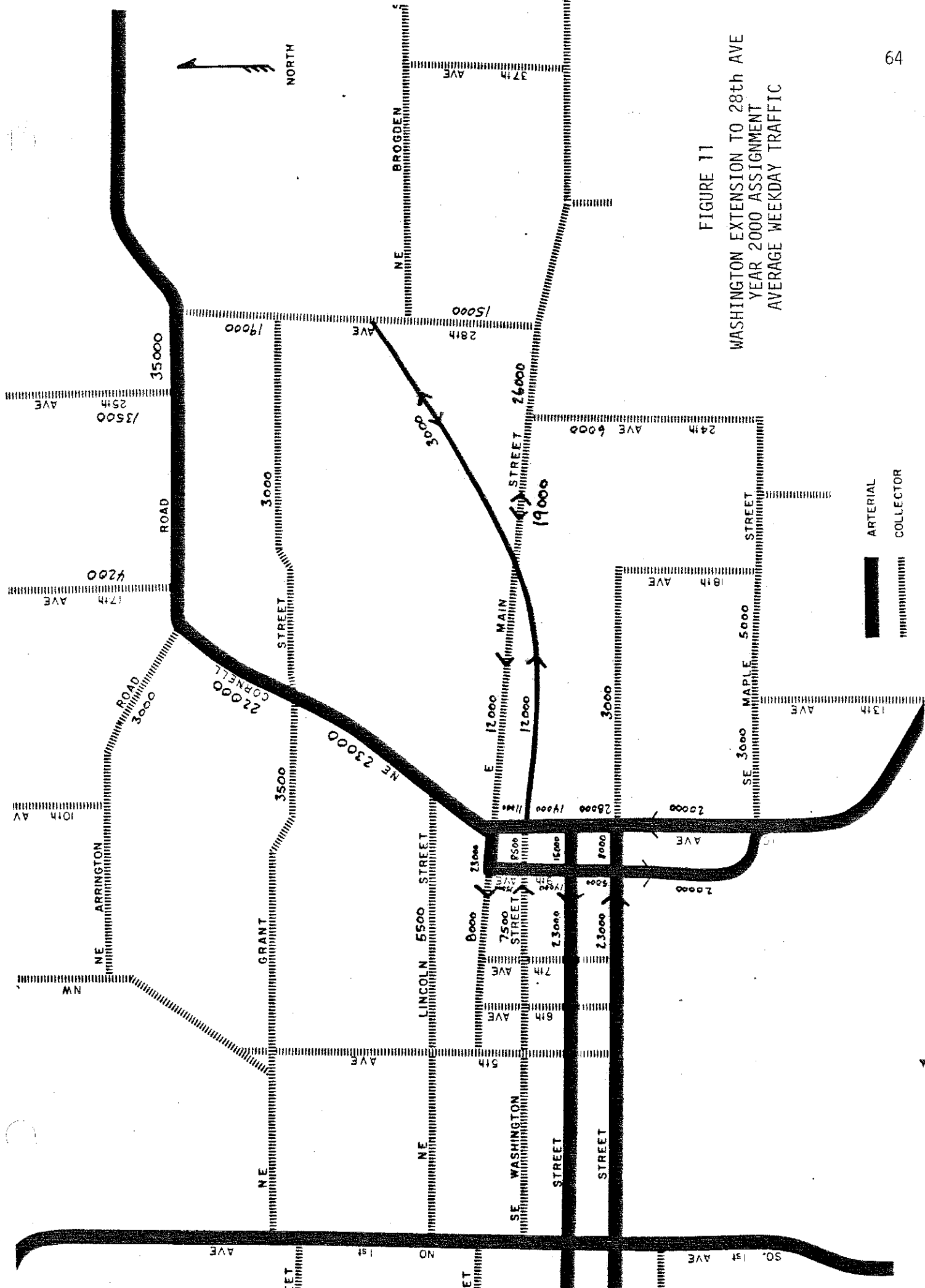
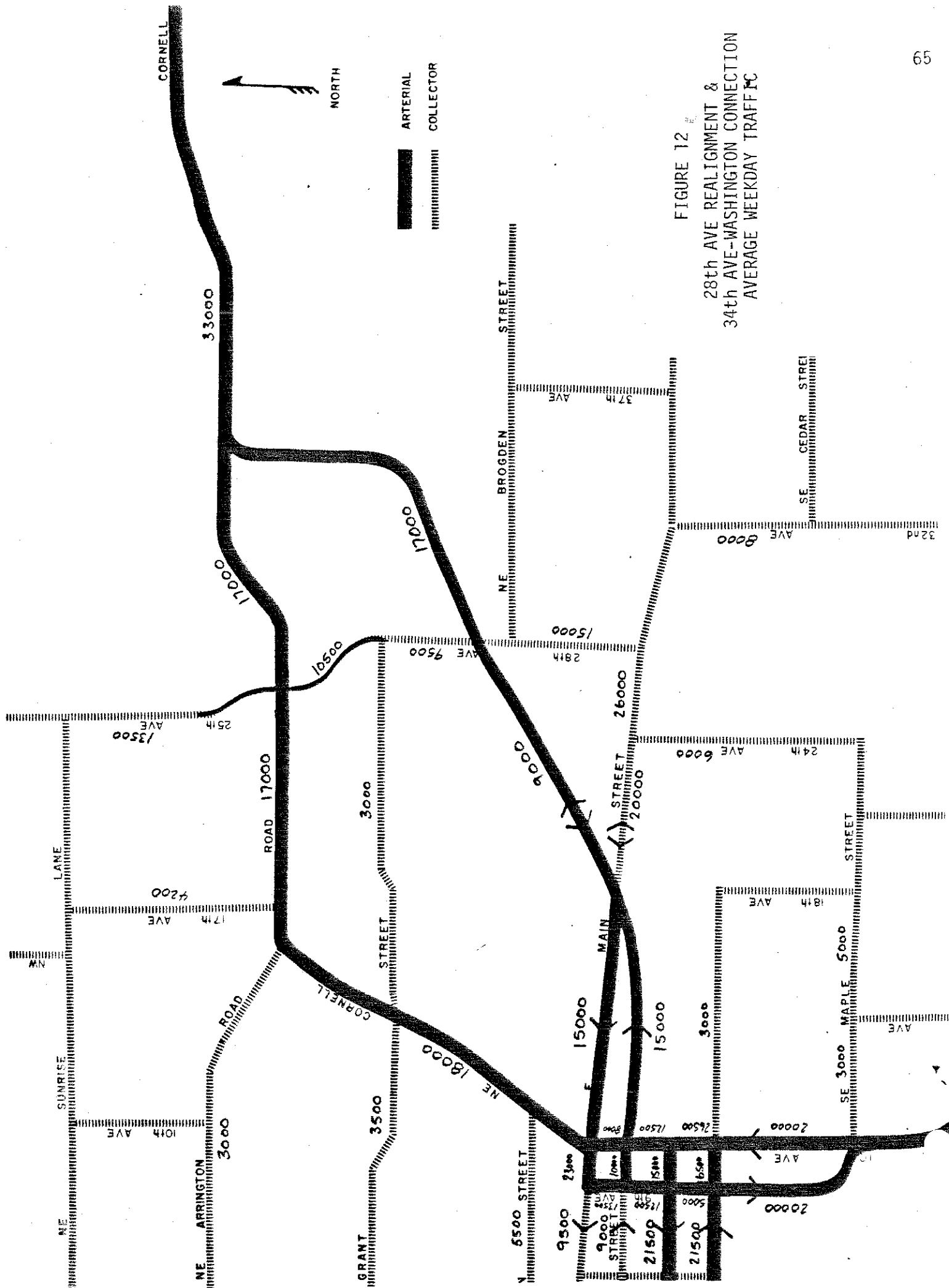


FIGURE 11  
WASHINGTON EXTENSION TO 28th AVE  
YEAR 2000 ASSIGNMENT  
AVERAGE WEEKDAY TRAFFIC



cost of extending Washington Street between 18th and Cornell Road would be approximately \$1,265,000. It is also estimated that this roadway would eliminate the need to widen Cornell Road between Main Street and Arrington Road and would only require a two-lane section with left turn lanes between Arrington Road and 34th Avenue. Therefore, the construction of this roadway would reduce the cost of the Cornell Road widening by approximately \$700,000.

As indicated on Figure 12, this alternative is expected to be effective by diverting traffic from Cornell Road to the Washington Street extension.

However, it is not a cost effective alternative since it would cost an additional \$565,000 to construct and it would have an adverse impact on the existing residential neighborhoods this road would pass through.

A review of utilizing the Burlington Northern Railroad right-of-way at the neighborhood workshops indicated most people opposed this type of modification and were more favorable to widening Cornell Road.

Therefore because this alternative is not cost effective in reducing the traffic impact, because it would adversely impact a residential neighborhood and because the citizens attending the workshops opposed this alternative, it is recommended that it be dropped from further consideration.

### 25th-28th Avenue Realignment

The realignment of 25th and 28th Avenues at Cornell Road to form one continuous north-south collector between Main and Evergreen Streets was investigated to reduce the traffic loading on Cornell Road.

It is expected that the year 2000 traffic demand between 25th and 28th Avenues would be approximately 8500 vehicles per day. Therefore, the realignment and connection of these two streets would reduce the volume on Cornell Road by 8500 vehicles per day between 25th and 28th Avenues. This realignment would simplify the intersection complex and reduce traffic congestion and overloading of Cornell Road at this location.

### Evergreen Road Extension

This alternative envisions the easterly extension of Evergreen Road from Shute Road to Cornelius Pass Road. The purpose of this extension would be to provide another east-west arterial from one end of the City to the other, to provide for increased traffic circulation around the City rather than through the center of the City and thereby to reduce the traffic demand on Cornell Road and on Oak and Baseline Street.

Figure 13 indicates the year 2000 traffic assignment to this alternative. It is expected that this extension would divert approximately 5000 vehicles per day from Cornell Road east of approximately 28th Avenue. Its impact on Oak and Baseline Streets is expected to be minimal.

The assigned volumes to Evergreen Road indicate that it could be a two-lane roadway with left turn lanes at major intersections and driveways. Traffic signals would be required at the intersection with Cornelius Pass Road and at other north-south collector streets. It is estimated that the extension of Evergreen Road between Shute Road and Cornelius Pass Road would cost approximately \$900,000.

#### First-Connell Avenue Couplet

The First-Connell Avenue couplet was tested to determine its effectiveness in reducing the traffic demand on First Avenue. The concept, as shown on Figure 14, would be to convert First Avenue to a one-way northbound roadway between Oak Street and the intersection with Connell Avenue and Glencoe Road. Connell Avenue would be converted to a one-way southbound roadway between the intersection with Glencoe Road and Oak Street. Connell Avenue would have to be extended southerly from W. Main Street to Oak Street for the couplet to be effective. In addition, a new street

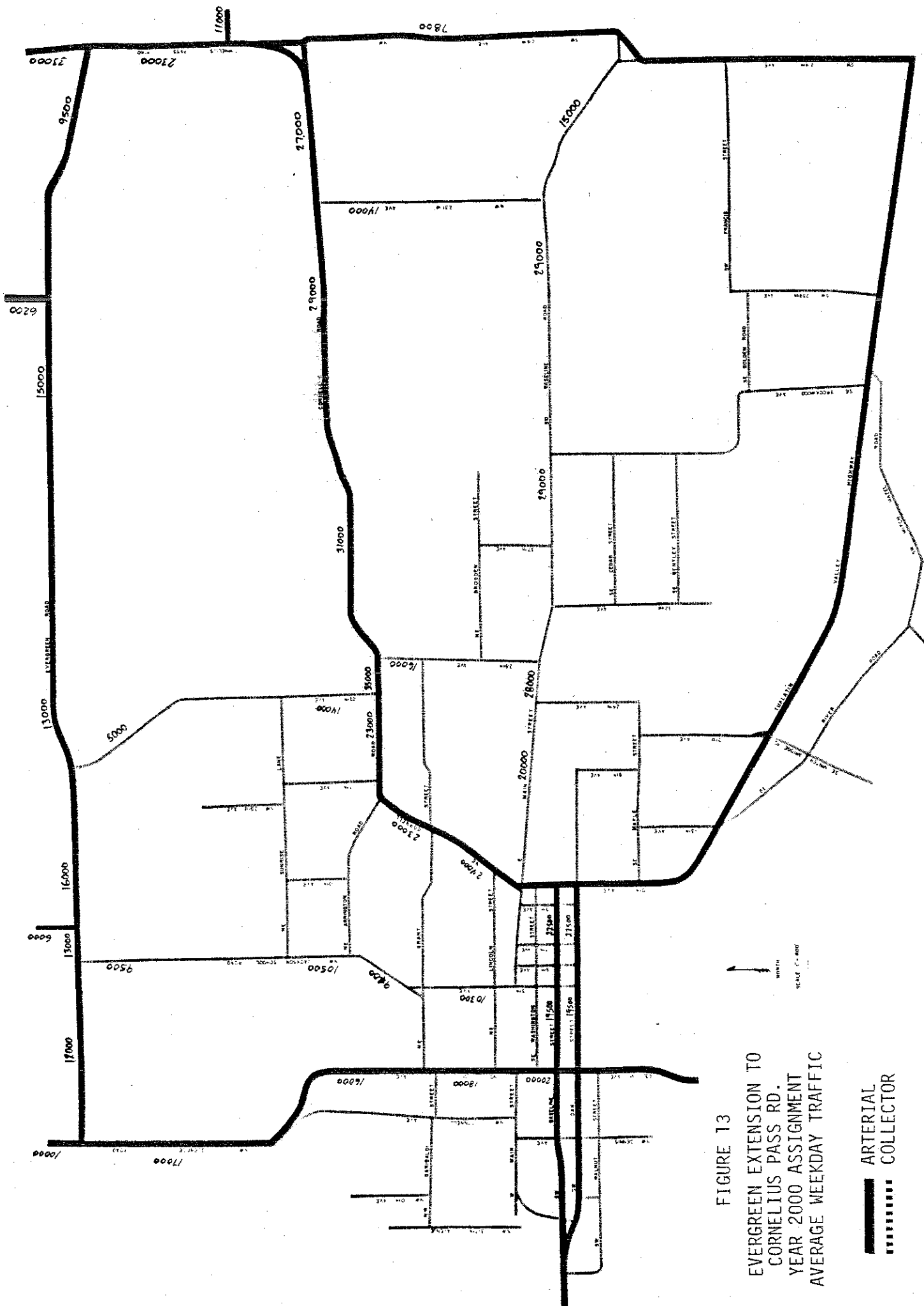


FIGURE 13  
EVERGREEN EXTENSION TO  
CORNELIUS PASS RD.  
YEAR 2000 ASSIGNMENT  
AVERAGE WEEKDAY TRAFFIC

ARTERIAL  
COLLECTOR

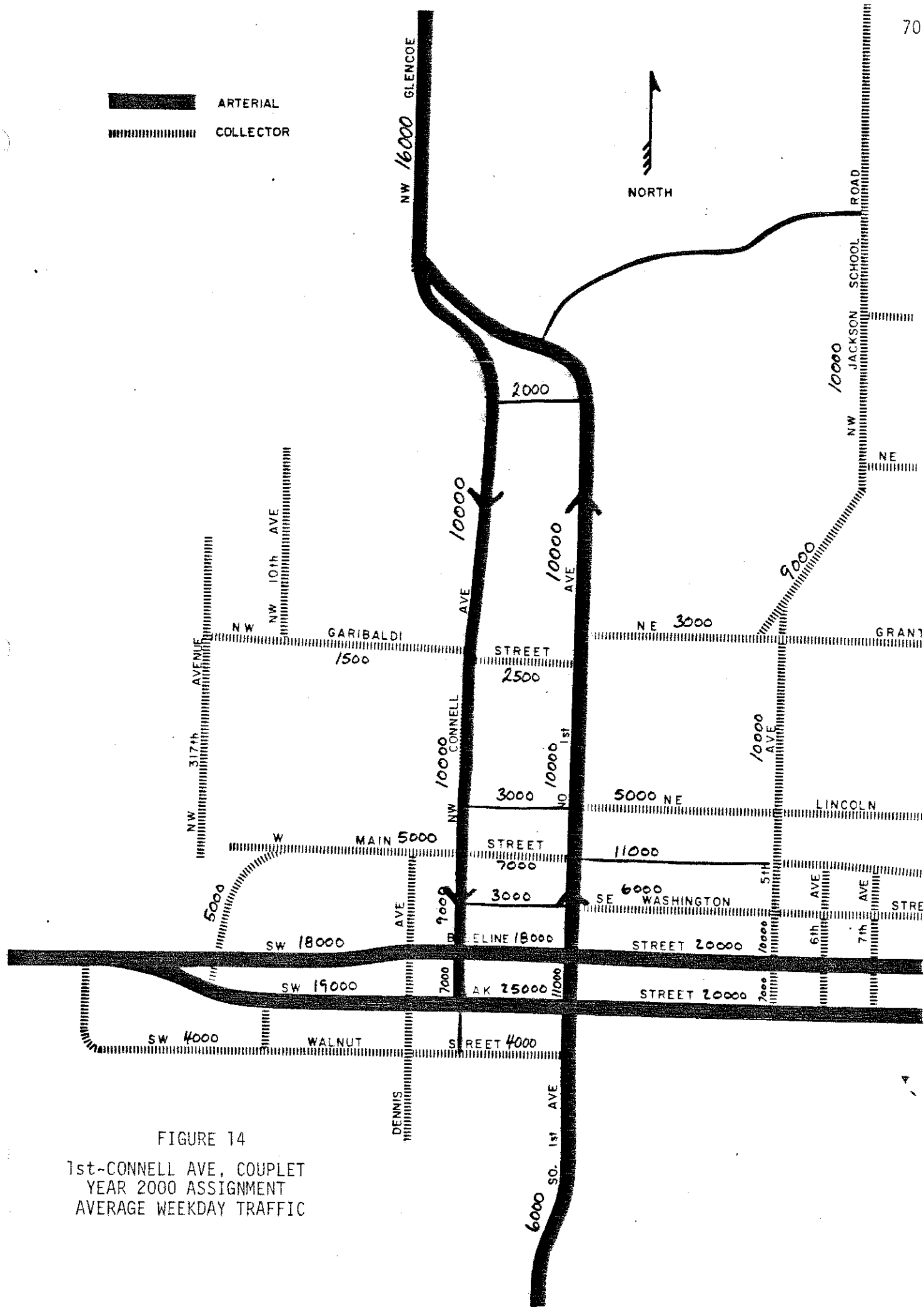


FIGURE 14  
 1st-CONNELL AVE. COUPLET  
 YEAR 2000 ASSIGNMENT  
 AVERAGE WEEKDAY TRAFFIC

between First and Connell Avenues would be required at the north end to provide for circulation around the couplet.

It is estimated that the installation of this couplet would cost approximately \$720,000. The southerly extension of Connell Avenue would require the purchase of some active businesses and some residences.

Figure 14 indicates that the traffic would be spread uniformly between First and Connell Avenues thus achieving the desired purpose.

However, the projected traffic could be accommodated on First Avenue as a two-way, two-lane roadway with left turn lanes north of Lincoln Street without this modification. Furthermore, the couplet would add approximately 7000 vehicles per day to Connell Avenue which is a residential collector street.

Because of the expense of extending Connell Avenue to the south and the adverse traffic impact added to Connell Avenue, it is recommended that this alternative be dropped from further consideration.

### Brookwood Avenue Northerly Extension

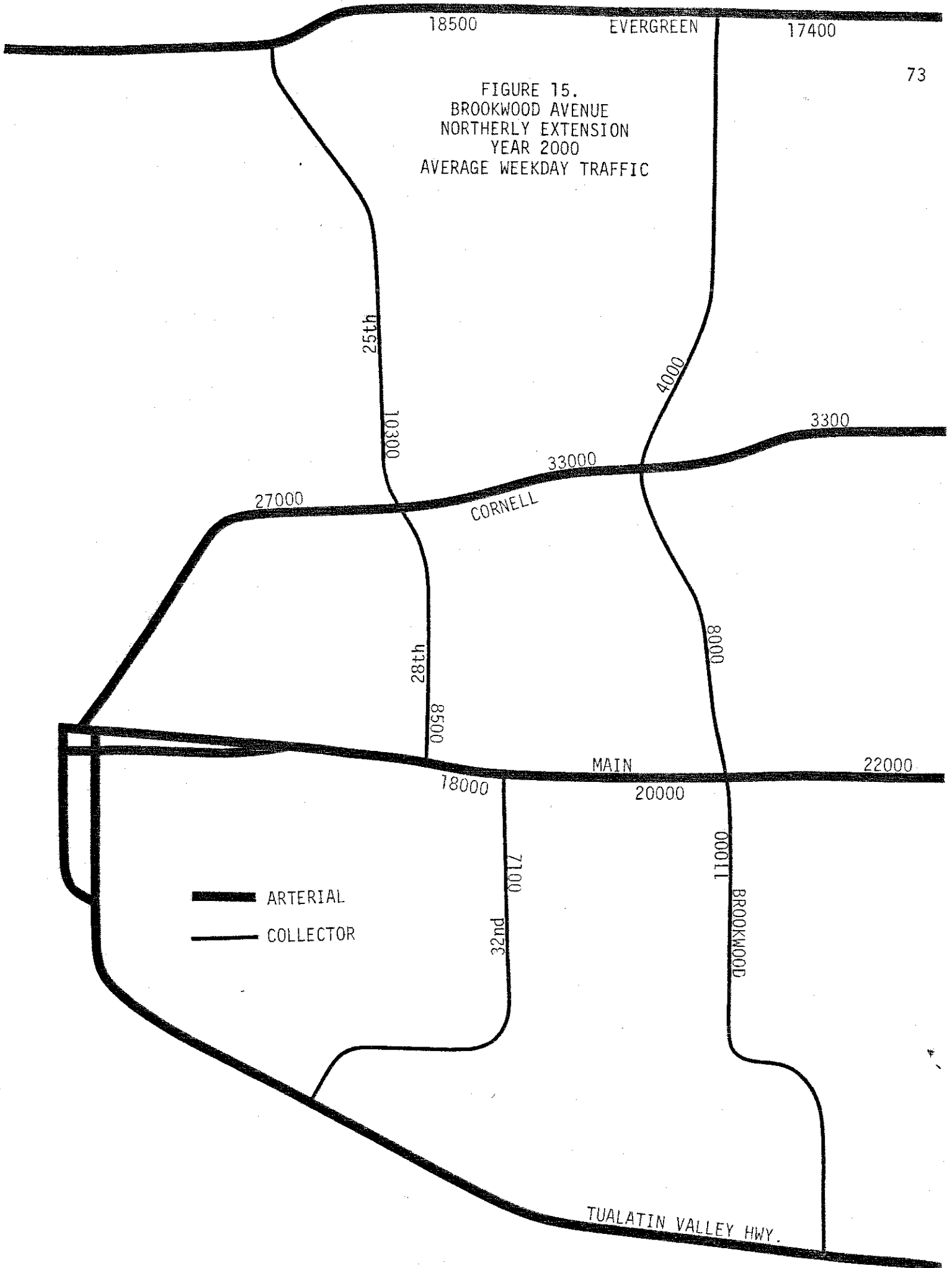
The concept of this alternative is to provide an additional north-south collector street between T. V. Highway and Evergreen Road to reduce the amount of out-of-direction travel and improve circulation within the City. In developing this alternative, it was hoped that traffic volumes on E. Main Street would be reduced.

Figure 15 indicates the concept of extending Brookwood Avenue north to Evergreen Road and the expected traffic loadings on the street system.

The effect of extending Brookwood Avenue north is expected to result in a reduction of traffic on 25th and 28th Avenues and on E. Main Street because of improved traffic circulation. The reduction of traffic on E. Main Street is expected to be great enough to reduce the cross-section from 64 feet to 40 feet. Brookwood Avenue would be a two-lane roadway with left turn lanes at key locations.

It is estimated that the extension of Brookwood Avenue north of Main Street would cost approximately \$1,135,000. However, a savings of approximately \$1,500,000 would result in constructing E. Main Street as a 40 foot rather than a 64 foot roadway.

FIGURE 15.  
BROOKWOOD AVENUE  
NORTHERLY EXTENSION  
YEAR 2000  
AVERAGE WEEKDAY TRAFFIC



Therefore, it is apparent that the extension of Brookwood Avenue not only improves traffic circulation within the City, it also is cost effective by reducing the capital expenditures on E. Main Street.

### Conclusion

It is concluded from these analyses that the most effective modifications of the existing street system to accommodate the growth for the next 20 years would be to implement the following:

- o Ninth-Tenth Avenue Couplet
- o Main-Washington Street Couplet
- o 25th-28th Avenue Realignment
- o Evergreen Road Extension to Cornelius Pass Road
- o Brookwood Avenue Extension to Evergreen Road
- o Widen other streets as previously described and reduced by the above modifications.

It is estimated that these modifications to the existing street system would cost approximately \$23,700,000 or \$1,050,000 more than the first alternative of only widening existing streets. This additional cost represents the capital cost of adding new facilities to improve traffic circulation and reduce out of direction travel and not just add street capacity.

## INCREASED PUBLIC TRANSPORTATION

Increasing public transportation to Hillsboro and within the City would also reduce the vehicle trip demand on the street system and provide additional mobility to those who cannot drive because of age or physical condition. Public transportation improvements in addition to what was assumed for the traffic forecasting element would include the following:

- o Provide City-wide local transit service radiating from the downtown area and penetrating the residential areas and areas of employment.
- o Increased express bus service to other cities to the east and to Forest Grove.
- o Development of light rail transit service between Hillsboro and other cities to the east.

It is also anticipated that these types of transit improvements would reduce the forecast traffic volumes on the City's street system and would make it possible to maintain a street system of mostly two-lane roadways rather than adding more four-lane roadways. However, these additional transit improvements are not likely to reduce the need for widening Cornell Road and Cornelius Pass Road but could insure that Main Street would be operational as a two-lane roadway.

## OTHER ACTIONS TO REDUCE TRAFFIC DEMAND

Other actions which the City could take to reduce the forecast traffic demand on the street system would include the overall management of the City's transportation system through the following:

- Develop ride sharing programs including carpools and vanpools with large employers.
- Develop a comprehensive program of staggered working hours or flex time at large employers or in concentrated employment sections of the City.
- Develop bikeways throughout the City and bicycle storage facilities.
- Develop improved sidewalks or pedestrian ways.
- Limit parking at high employment areas and provide other transportation modes.
- Locate park-and-ride facilities for TRI-MET to reduce vehicular use in the City and by City's residents and to encourage use of local feeder buses.
- Encourage mixed or joint use developments to encourage walking between buildings or uses and reduce the need to drive between different buildings.

- Improve methods of goods movement and deliveries.
- Monitor system effectiveness.

This management function would probably be the most effective if it were part of the City Managers Office so that other City departments could easily be coordinated and to receive maximum cooperation from other public agencies and the private sector.

## RECOMMENDED PLAN

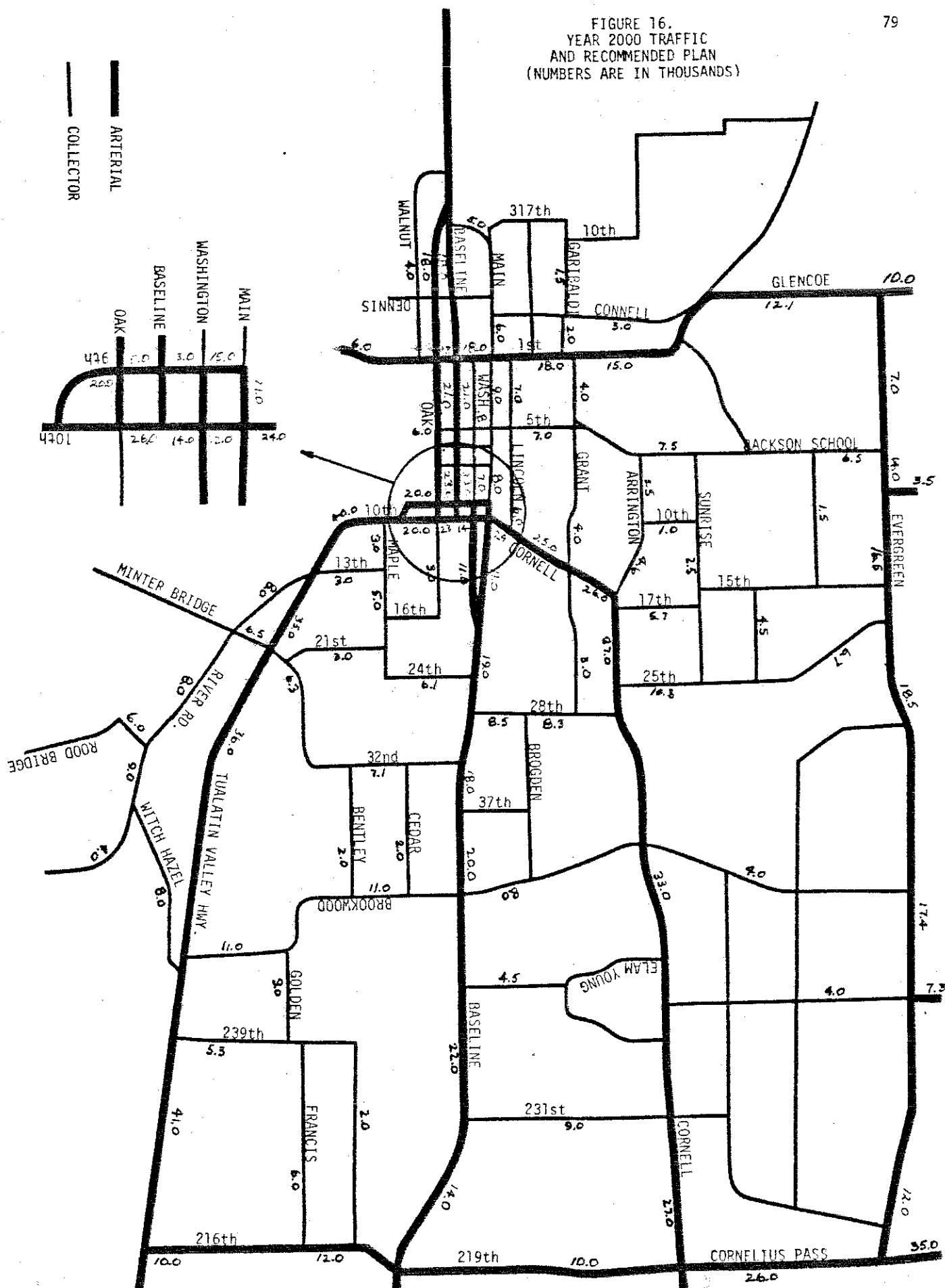
The recommended transportation plan includes a functional street classification, street width standards, street improvements, guidelines for public transportation service and a bikeway plan.

Figure 16 indicates the assignment of year 2000 average weekday traffic to the recommended street plan.

## STREET CLASSIFICATIONS AND STANDARDS

Street standards are a design form which relate to roadway function and operational characteristics such as traffic volume, operating speed, safety and capacity. Street standards are necessary to provide a community with roadways which have been determined through extensive research and experience to be relatively safe, aesthetic and easy to administer when new roadways are planned or constructed. The functional street classification and definitions were describes previously in this report.

FIGURE 16.  
YEAR 2000 TRAFFIC  
AND RECOMMENDED PLAN  
(NUMBERS ARE IN THOUSANDS)



Experience has indicated that the design of a residential street and the subdivision in which it is located will affect the traffic operation, safety and livability on such a street.

Generally, when the average weekday traffic volume exceeds approximately 1200 vehicles per day on a local residential street, the residents on that street become aware of the traffic and complain to various city departments about increasing traffic, noise and potential accidents. The traffic volume on a local residential street generally averages approximately 400 to 500 vehicles per day.

Accident analyses<sup>1</sup> on local residential streets have indicated that the optimum width, curb-to-curb is 32 feet. It has also been observed that when traffic volumes reach approximately 5000 vehicles per day on residential streets, accidents oriented to driveways become identifiable by location.

Sidewalks located adjacent to the curb generally contain mailboxes, street light standards and sign poles and are affected by opening car doors thus reducing the effective width of the walk. To maintain a safe and convenient walkway

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<sup>1</sup>Box, Paul C. "Traffic Safety Studies in Smaller Communities," Public Works, December, 1971.

for at least two adults, it is recommended that a five foot sidewalk located adjacent to the property line be utilized in residential areas. A planting strip would be located between the sidewalk and street.

Therefore, these general observations and analyses have been utilized in the development of the street standards. The development of the street standards have also utilized policies and publications of the profession.<sup>1</sup>

#### Cul-de-Sac Streets

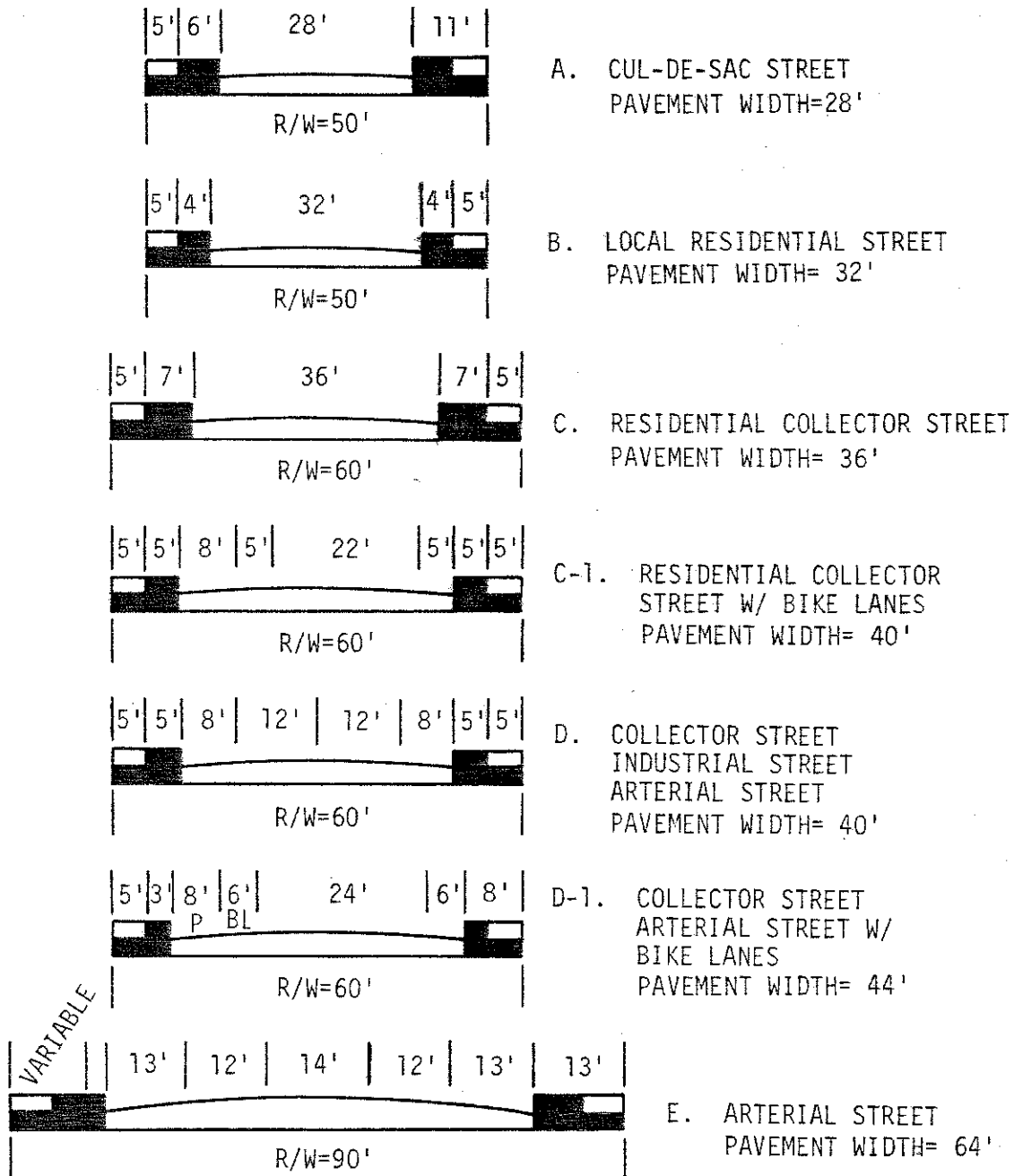
Cul-de-sac streets are intended to serve the abutting land in residential areas. These streets should be less than 600 feet in length serving a maximum of 20 single family houses. The recommended street width is 28 feet curb to curb within a 50 foot right-of-way as shown in Section A, Figure 17. On each side of the roadway, a five foot wide sidewalk should be located adjacent to the outside edge of the right-of-way permitting a six foot planting strip between the street and sidewalk.

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<sup>1</sup>Recommended Practices for Subdivision Streets, Institute of Transportation Engineers.

Residential Streets, Objectives, Principles and Design Considerations, the Urban Land Institute, American Society of Civil Engineers and the National Association of Home Builders.

## RECOMMENDED STREET STANDARDS



The circular paved turning area at the end of the cul-de-sac should have a radius of 40 feet to the face of curb to permit curb parking and vehicles to turn around. Some large moving vans may be required to negotiate the turn through several maneuvers. Alternatives to a circular paved area could be considered on a case by case basis.

#### Local Residential Streets

Local residential streets are intended to serve the abutting land without carrying through traffic. These streets should be designed to carry less than 1200 vehicles per day. If the forecast volume exceeds 1200 vehicles per day, as determined in the design stage, the street system configuration should either be changed to reduce the forecast volume or the street should be designed as a residential collector street.

The local residential street would generally extend for only a few blocks to maintain a volume of less than 1200 vehicles per day. The traffic volume can be estimated by utilizing the trip rates, the area tributary to each local residential street and the number and type of dwellings in that area.

The local residential street should be designed as a 32 foot roadway, curb-to-curb within a 50 foot right-of-way, as shown in Section B on Figure 17. Sidewalks five feet wide should

be provided on each side of the roadway and located adjacent to the right-of-way line.

The 32 foot cross-section will accommodate passage of one lane of moving traffic in each direction with occasional curb parking. On low volume residential streets where curb parking might occur on both sides of the street, one lane of traffic will move freely. This condition has been found acceptable in residential areas where curb parking does not extend for great distances. The level of residential inconvenience caused by the lack of two moving lanes is remarkably low.

In cases where residential streets are constructed in areas of difficult terrain or in special design situations associated with planned unit developments, the width of the street could be reduced to 24 feet curb face to curb face without curb parking. In these situations, however, adequate off-street parking must be provided with each dwelling and where possible the roadway widened to provide parking bays. The provisions of sidewalks in these situations should be decided by the City at the time of design.

#### Residential Collector Streets

Residential collector streets are intended to serve the

abutting land and carry through traffic from other parts of the neighborhood. As shown on Figure 17, Section C, it is a 36 foot roadway, curb face to curb face, within a 60 foot right-of-way. A five foot sidewalk should be located on each side of the roadway adjacent to the right-of-way line. This street section provides for two travel lanes plus curb parking on both sides of the street. However, when parking occurs on both sides of the street, the effective travel lane width is reduced to ten feet. The traffic carrying capacity of the residential collector is approximately 7000 vehicles per day. If volumes are forecast to be under 1200 vehicles per day, one should not reduce the cross-section to a local residential street when this street is performing a collector function.

In cases where a bikeway is to be provided with a residential collector street, it is recommended that the street be designed 40 feet wide as indicated in Section C-1 on Figure 17. In this manner, a five foot bikeway can be provided on each side of the roadway plus parking on one side only and provide for 22 feet of travel way for vehicular traffic.

If traffic volumes are forecast to be in excess of 5000 vehicles per day on residential collector streets, then driveways serving single family houses, duplexes or triplexes should not be permitted on that section of roadway.

As with local residential streets, in cases where a collector street is constructed in an area of difficult terrain or in special design situations, the width of the roadway could be reduced to 28 feet without curb parking. However, adequate off-street parking must be provided at the abutting properties and the street should be widened where possible to provide parking bays. At intersections with other collector streets or arterials, the roadway should be widened to accommodate a left turn lane.

#### Collector Streets

Collector streets are intended to serve abutting lands and through traffic from within the neighborhood. The collector street would serve residential, commercial or industrial land uses. As shown on Figure 17, Section D, it is a 40 foot roadway, curb to curb within a 60 foot right of way.

Sidewalks five feet wide should be provided on each side of the roadway and adjacent to the right of way line in residential and industrial areas. In commercial areas, the sidewalks should be at least eight feet wide and located adjacent to the curbs.

The 40 foot pavement width provides for two 12 foot travel lanes plus curb parking on each side of the street or two

13 foot travel lanes and a 14 foot left turn lane in the median area.

The minimum width for an industrial roadway is 40 feet to permit adequate space for semi-trailer trucks to turn without interfering with opposing traffic.

In cases where a bikeway is to be provided along a collector street, it is recommended that the street be 44 feet wide as indicated in Section D-1. In this manner, two six foot wide bikeways can be provided on each side of the street, curb parking on one side only and 24 feet of travel way for vehicular traffic. At major intersections where left turn lanes are required, the curb parking would be eliminated and the bikeways reduced to four feet wide to provide three 12 foot travel lanes.

The traffic carrying capacity is approximately 10,000 vehicles per day with curb parking and 18,000 vehicles per day with no parking and left turn lanes.

If traffic volumes are forecast to be in excess of 5000 vehicles per day then driveways serving single family houses, duplexes or triplexes should not be permitted on that section of roadway.

As with residential streets, in cases where a collector street is constructed in an area of difficult terrain or in

special design situations, the width of the roadway could be reduced to 28 feet without curb parking. However, adequate off-street parking must be provided at the abutting properties and the street should be widened where possible to provide parking bays. At intersections with other collector streets or arterials, the roadway should be widened to accommodate a left turn lane.

#### Arterial Streets

Arterial streets are intended to provide for the movement of traffic between areas and across portions of a city or region. Residential property, except for large multi-family complexes, should not face or be provided with access on arterial streets. If the arterial street volume is forecast to be less than 18,000 vehicles per day, then the cross-section for a collector street with a 40 foot roadway width curb face to curb face could be utilized. For areas where the arterial street volume is forecast to be in excess of 18,000 vehicles per day, then a four lane plus left turn lane cross-section should be utilized.

Section E is a 64 foot width roadway, curb face to curb face, which provides for two travel lanes in each direction plus left turn lanes at intersections or throughout the roadway. When left turn lanes are provided only at inter-

sections, curb parking could be provided on each side of the street between intersections. This roadway section requires a 90 foot right-of-way. The traffic carrying capacity of Section E is approximately 32,000 vehicles per day.

Sidewalks should be located on each side of the roadway adjacent to the right-of-way lines except in commercial areas where they should be located adjacent to the curbs. Five foot sidewalks should be provided in residential or industrial areas and at least eight foot sidewalks in commercial areas.

In cases where a bikeway is to be located along an arterial, it should be provided in accordance with Section D-1 for a two lane arterial and as a separate eight foot bikeway in lieu of a sidewalk on one side of the street for a four lane arterial. The eight foot bikeway should be located adjacent to the right-of-way line.

A summary of the basic roadway standards indicating general design capacity in vehicles per day is shown on Table 9.

TABLE 9  
STREET STANDARDS

| Section | Classification                     | Pavement Width in Feet | Right of Way Width in Feet | Design Capacity Vehicles Per Day |
|---------|------------------------------------|------------------------|----------------------------|----------------------------------|
| A       | Cul-de-Sac                         | 28                     | 50                         | 200                              |
| B       | Local Residential                  | 32                     | 50                         | 1,200                            |
| C       | Residential Collector              | 36                     | 60                         | 7,000                            |
| C-1     | Residential Collector and Bikeway  | 40                     | 60                         | 7,000                            |
| D       | Collector, Industrial and Arterial | 40                     | 60                         | 10,000-18,000                    |
| D-1     | Collector & Arterial with Bikeway  | 44                     | 60                         | 10,000-18,000                    |
| E       | Arterial                           | 64                     | 90                         | 32,000                           |

Note: Design capacities based on level of service "D," 5 percent commercial vehicles, 10 percent right turns, 10 percent left turns, peak hour factor 85-90 percent, peak hour directional distribution 55 to 60 percent, peak hour 9-12 percent of daily volume and average signal timing for collector and arterial streets.

## STREET IMPROVEMENTS

The recommended street plan is shown on Figure 18. The general concept of the street plan is to provide an arterial street system which surrounds the city and passes through it in the east-west direction.

Collector streets would provide increased north-south traffic circulation as well as general intra-city circulation.

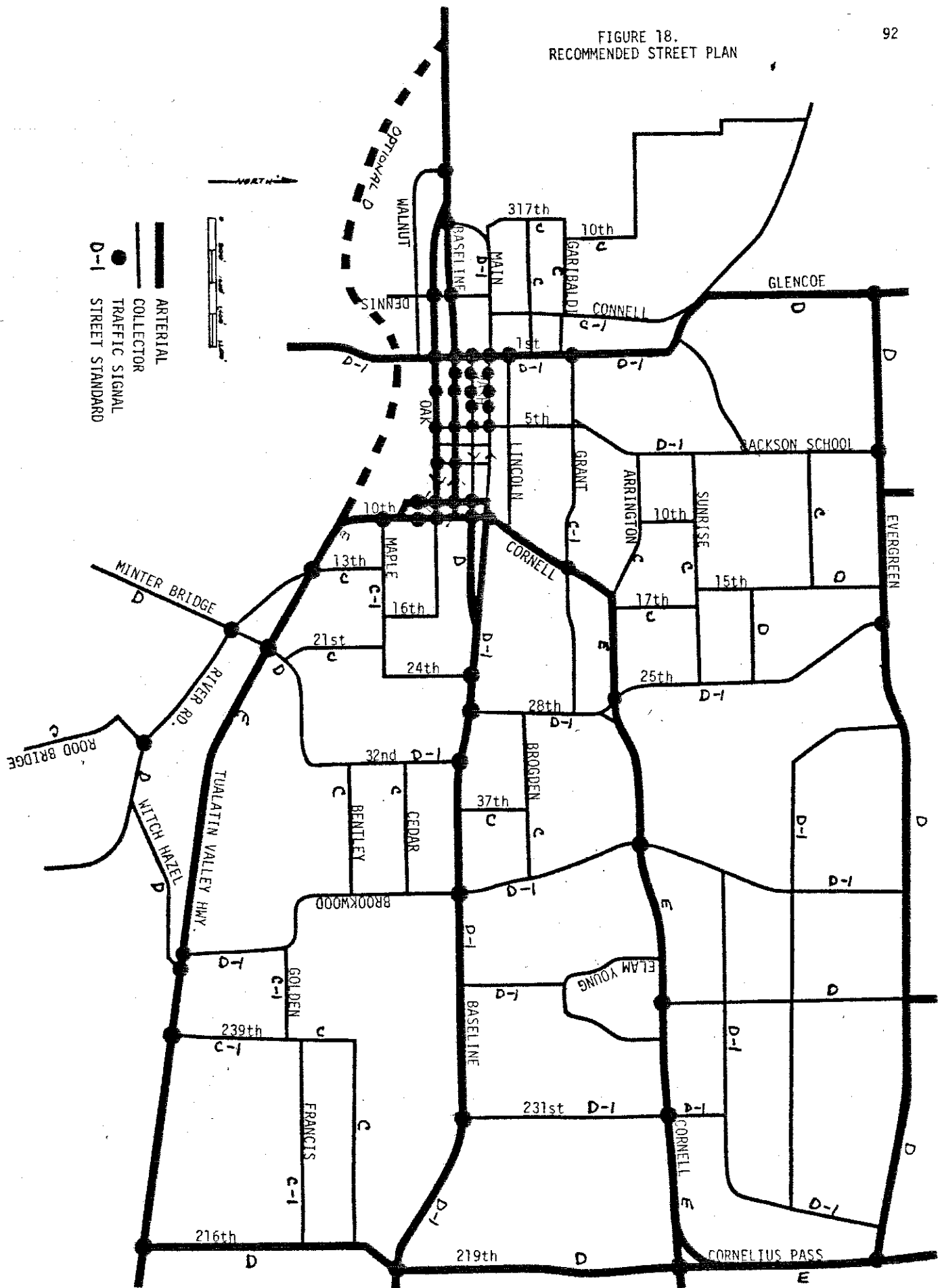
Improved access to the Sunset Highway is also proposed via Shute and Jackson Roads.

The following is a description of the recommended street improvements to the existing network. These improvements are listed for the arterials and collector streets.

### ● Arterials

#### Evergreen Road

It is recommended that Evergreen Road be developed as an arterial street between Glencoe and Cornelius Pass Roads. The purpose of Evergreen Road is to provide a second east-west arterial between the northerly portion of the city and Sunset Highway and to provide a distribution function along the northerly edge of the city.



As indicated on Figure 16, its forecast traffic is expected to range between 7,000 and 18,000 vehicles per day by the year 2000. Therefore, it is recommended that Evergreen Street be developed as a 40 foot roadway in accordance with street standard D to provide one travel lane in each direction plus left turn lanes at intersections and major driveways and no curb parking. Traffic signals will be required at the intersections with Glencoe Road, Jackson School Road, 25th Avenue, Shute Road, and at Cornelius Pass Road. A separate eight foot wide bike path is recommended along the south side and adjacent to the roadway.

#### Cornell Road

It is recommended that Cornell Road be widened to a four lane arterial throughout its entire length in Hillsboro. Between Main Street and approximately Arrington Road, it is recommended that the existing 40 foot pavement be widened to 48 feet to provide four 12 foot travel lanes. An additional 10 to 12 foot widening is also recommended on each side of the intersection with Grant Street to provide protected left turn lanes. Curb parking would be prohibited between 7:00 a.m. and 7:00 p.m. to provide the required street capacity.

It is recommended that Cornell Road be widened between Arrington Road and Cornelius Pass Road to a 64 foot roadway to provide two travel lanes in each direction plus a continuous left turn lane and no curb parking. In sections where there are no intersections or driveways, the left turn lane could be eliminated by a landscaped median or a narrowing of the roadway to 52 feet between curbs. It is further recommended that access control be established on this section of roadway to minimize driveways and maintain a high capacity. Wherever possible, new developments along Cornell Road should have access oriented to major cross streets and parallel roads rather than individual driveways along Cornell Road. If exceptions to this case are granted, then driveways serving more than one development should be provided to minimize the number of conflicts along the roadway.

It is also recommended that the section of Cornell Road east of Cornelius Pass Road be relocated to be a direct extension of Cornell Road west of Cornelius Pass Road as shown on Figure 18. The intersection between Cornell Road and Cornelius Pass Road should be rebuilt and signalized as shown on Figure 19.

Traffic signals will be required along Cornell Road at the intersections with Main Street, Grant Street, 25th Avenue, Brookwood Avenue, Shute Road, 231st Avenue, at Cornelius

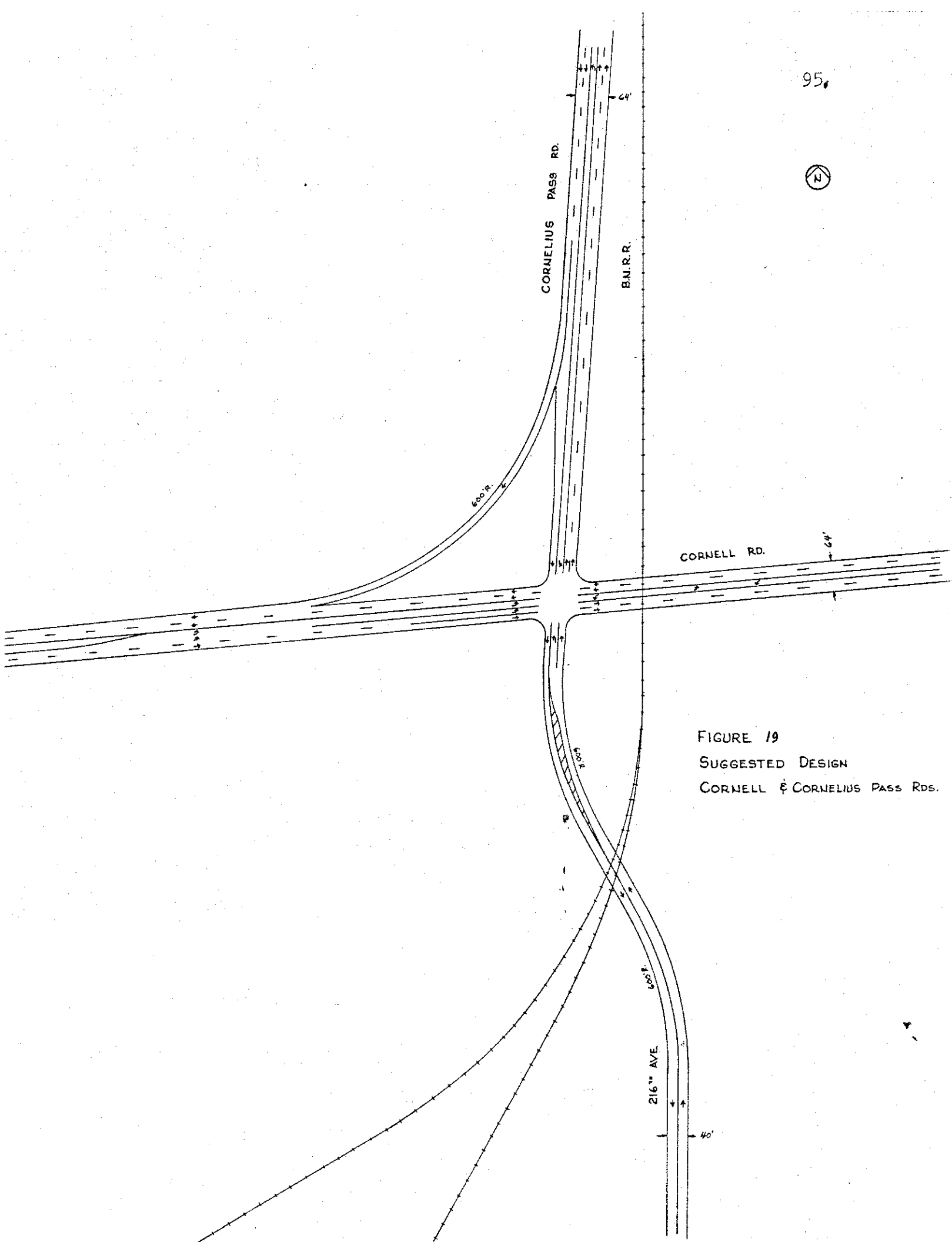


FIGURE 19

SUGGESTED DESIGN

CORNELL &amp; CORNELIUS PASS RDS.

Pass Road and at the intersections with Elam Young Parkway. These signals should be interconnected to provide a progression of the traffic flow.

A separate eight foot wide bikeway is recommended to be constructed on the south side of the right of way east of 17th Avenue.

#### Main Street

It is recommended that Main Street be developed as an arterial street between Ninth Avenue and east of the city limits. West of Ninth Avenue it should function as a collector street.

It is recommended that Main Street be developed into a one-way couplet with Washington Street between First and 18th Avenues. Main Street would function westbound and Washington Street would function eastbound.

Between 10th and 18th Avenues, it is recommended that Main Street be widened to 40 feet in accordance with street section D. It should be striped for two 13 foot westbound lanes, a six foot bike lane on the north side of the roadway and an eight foot parking lane on the south side of the roadway.

East of 18th Avenue, it is recommended to be a two lane two-way arterial 44 feet wide in accordance with street standard D-1. Bikeways six feet wide are proposed on each side of the roadway and curb parking on only one side. Traffic signals will be required at the intersections with 10th, 24th, 28th, 32nd, Brookwood, 231st and 216th Avenues. Left turn lanes will be required at all major intersections, thus eliminating curb parking. Because Main Street functions as an arterial and will carry some 14,000 to 22,000 vehicles per day, it is recommended that all future residential developments be designed so as not to front on Main Street and that all vehicular access for these developments be provided on cross or parallel streets.

#### Washington Street

It is recommended that Washington Street function as a one-way eastbound arterial street east of Ninth Avenue and a one-way eastbound collector street west of Ninth Avenue. It should be developed 40 feet wide east of 10th Avenue along the old Burlington Northern railroad right of way to approximately 18th Avenue where it will intersect with Main Street. It should be striped for two eastbound lanes, a bikeway on the south side of the roadway and curb parking on the north side. A suggested design for the intersection between Main and Washington Streets is shown on Figure 20.

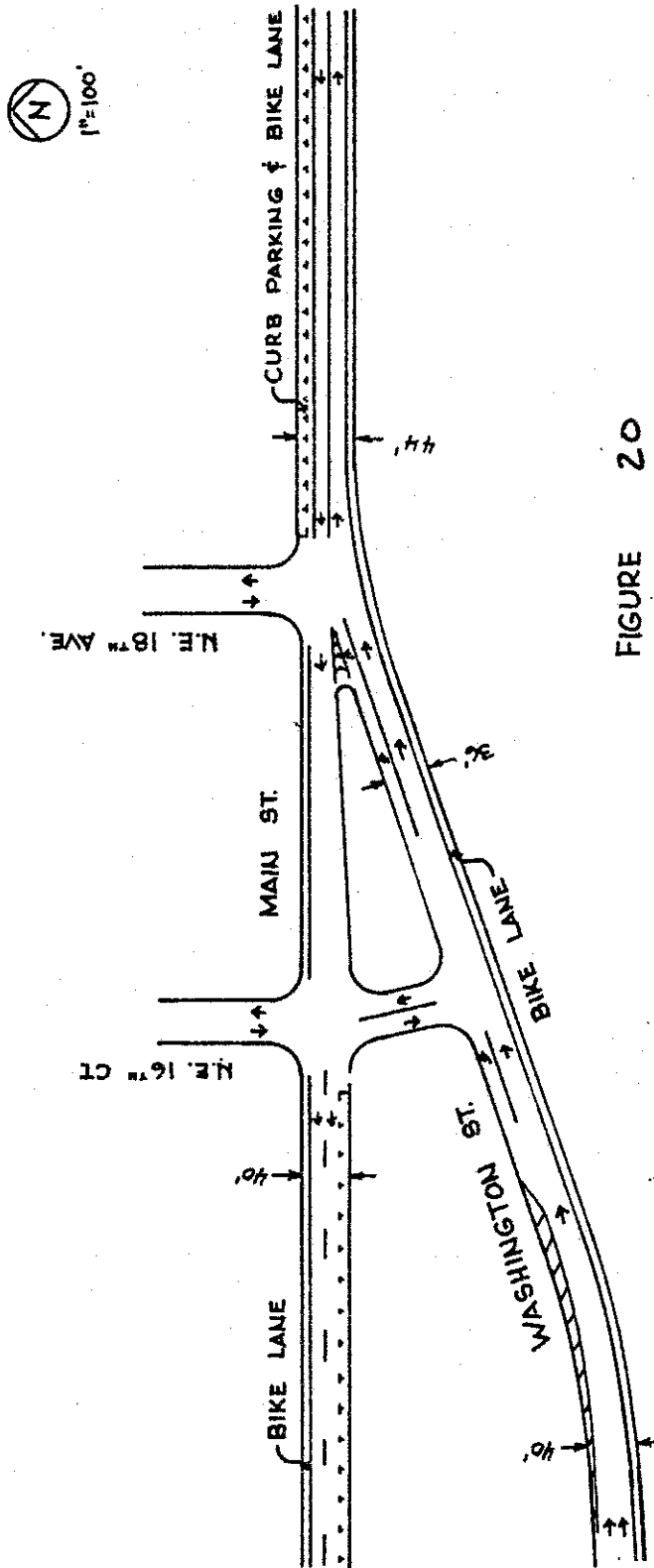


FIGURE 20  
SUGGESTED DESIGN  
MAIN & WASHINGTON STREETS

### Baseline Street

It is recommended that Baseline Street function as a three lane westbound arterial from 10th Avenue to the intersection with T.V. Hwy. West of Dennis Avenue it currently is only two lanes wide. Therefore, it is recommended that it be widened to 44 feet to provide three travel lanes plus one curb parking lane and that the right of way be widened from 60 feet to 66 feet to match the right-of-way to the east. It is further recommended that the westbound three lanes taper to two lanes west of the intersection with SW 17th Avenue.

It is also recommended that all traffic signals on Baseline Street be modified with new controllers to provide for a variation in cycle length and to be interconnected with a computerized system.

### Oak Street

It is recommended that Oak Street function as a three lane eastbound arterial between the intersection with T.V. Hwy. and Ninth Avenue. The existing street is 44 feet wide and provides three travel lanes plus curb parking. The only modification necessary to Oak Street will be at the intersection with Ninth Avenue and will be discussed in the

section describing Ninth and Tenth Avenues. All traffic signals on Oak Street should be modified as recommended on Baseline Street and interconnected to a computerized control system.

#### T.V. Highway

It is recommended that T.V. Hwy. function as a four lane arterial with left turn lanes in the median area west of the intersections with Oak and Baseline Streets and east of Tenth Avenue. T.V. Hwy. currently provides for four travel lanes and left turn lanes except between Tenth and Minter Bridge Road there are no left turn lanes. Therefore, it is recommended that T.V. Hwy. be widened to accommodate a continuous left turn lane west of Minter Bridge Road. New traffic signals will be required at the intersections with Brookwood Avenue, 239th Avenue and 219th Avenue. These signals should be interconnected with those on Baseline and Oak Streets and on Ninth and Tenth Avenues to provide traffic progression throughout the length of the city.

Eight foot sidewalks should be provided on the north side of T.V. Hwy. and an eight foot two-way bike path on the south side of the highway and behind the curb east of Tenth Avenue. West of the intersection with Oak and

Baseline Streets, a five foot sidewalk should be provided on the north side and an eight foot two-way bike path on the south side of T. V. Hwy.

It is recommended that the access for all new developments along T. V. Hwy. be designed as joint driveways with adjacent properties wherever possible to minimize the number of driveway cuts and turning conflicts on T. V. Hwy.

#### First Avenue-Glencoe Road

It is recommended that First Avenue and Glencoe Road function as an arterial roadway in the north-south direction.

First Avenue varies in width from 26 to 30 feet south of Walnut Street, to 50 feet between Walnut and Lincoln Streets and 36 feet north of Lincoln Street to Glencoe Road.

It is recommended that First Avenue be widened south of Walnut Street to approximately Wood Street to 44 feet in accordance with street standard D-1 to provide two travel lanes, a six foot bikeway on each side of the travelway and curb parking on one side of the road.

Between Walnut and Lincoln Streets it should remain as a four lane roadway. However, its lane markings should be modified to provide two northbound travel lanes between Walnut and Lincoln Streets and that the center northbound lane be marked for an optional left turn and through lane at Baseline and Main Streets and left turns only at Lincoln Street. In the southbound direction the center southbound lane should also be marked for an optional left turn or through lane at Lincoln and Washington Streets and left turn only at Oak Street. The southbound curb lane at Oak Street should also be marked for an optional left turn lane and through lane. Figure 21 indicates the recommended striping for First Avenue. Traffic signals will eventually be required on First Street at the intersections with Washington, Main and Lincoln Streets. These signals together with those at Oak and Baseline Streets should be interconnected and phased to permit the northbound to westbound left turn phases to lead the through movement and the southbound to eastbound to follow the through movements.

North of Lincoln Street, First Avenue should be widened to 44 feet in accordance with street standard D-1 to provide two travel lanes and a bikeway on each side of the roadway. Glencoe Road should be widened in accordance with street standard D to a 40 foot roadway and provide a two-way eight

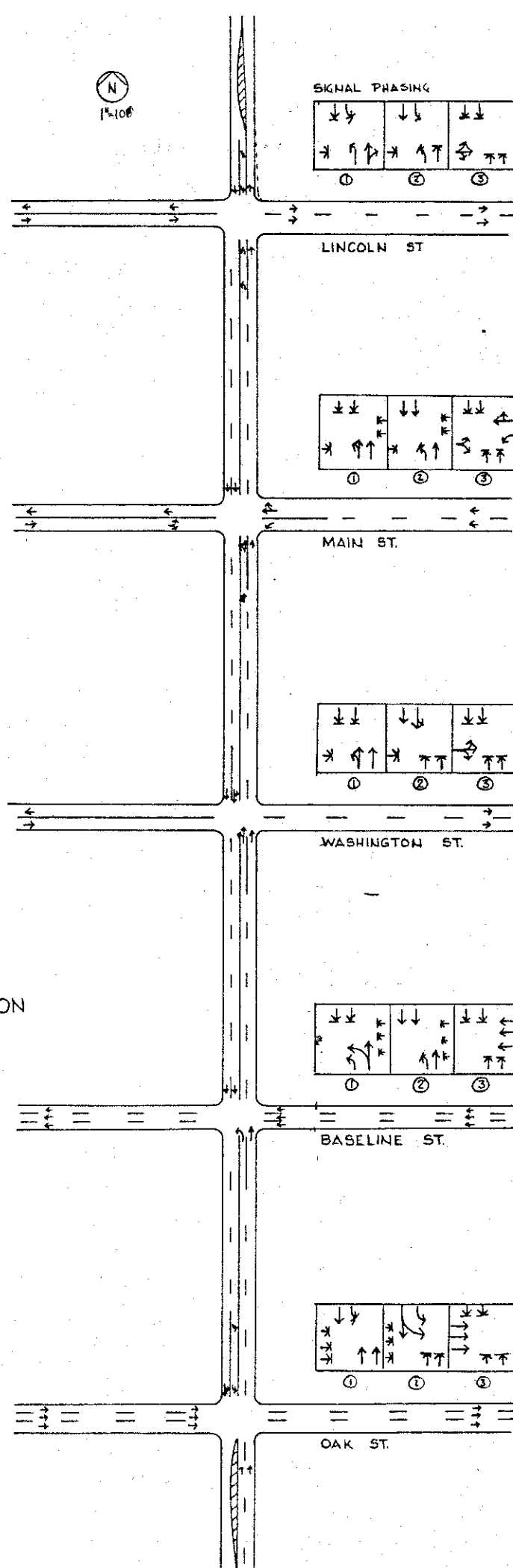


FIGURE 21  
RECOMMENDED OPERATION  
FIRST AVENUE

foot bikeway along one side of the roadway and behind the curb.

Between Lincoln and Evergreen Streets, it should be striped for one travel lane in each direction plus left turn lanes at major intersections.

The intersections with Grant and Evergreen Streets will require traffic signals in the future.

#### Ninth and Tenth Avenues

It is recommended that Ninth and Tenth Avenues be developed as a one-way couplet system between Main and Cedar Streets. South of Cedar Street, Tenth Avenue should be widened 18 feet on the west side to provide two travel lanes in each direction plus a left turn lane in the median area.

Figure 22 indicates the recommended geometrics for this street system improvement. Tenth Avenue is proposed to function as a one-way northbound roadway to Main Street. North of Cedar Street, it would be striped for three northbound lanes plus one parking lane. At the intersection with Baseline Street, two lanes would turn right and two lanes continue north. The center northbound lane in Tenth Avenue would be an optional left turn or through lane. Between Baseline and Main Streets, it would be striped for

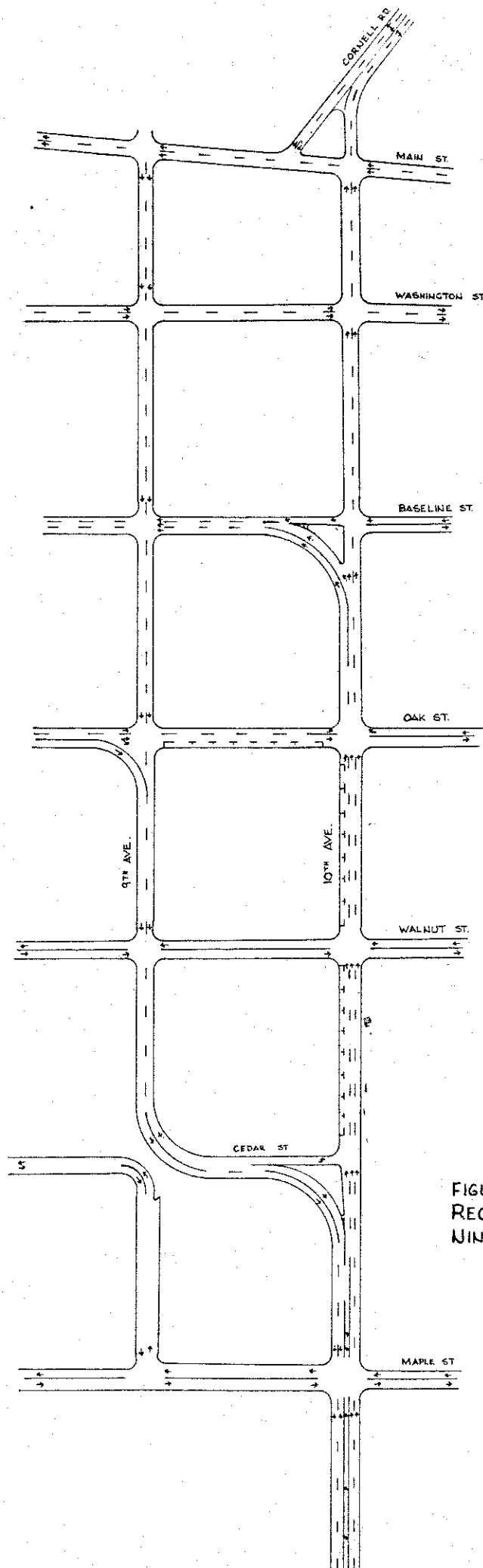


FIGURE 22  
RECOMMENDED  
NINTH-TENTH COUPLET

two northbound travel lanes and one parking lane. Two travel lanes would continue north from Main Street to northbound Cornell Road.

As indicated on Figure 22, the southbound traffic from Cornell Road would be routed on Main Street to Ninth Avenue and then south on Ninth Avenue to Cedar Street. The street modifications for southbound traffic would include the construction of a 100 foot radius curve at the intersection with Oak Street for eastbound to southbound traffic which would replace the existing large radius right turn curve at Tenth Avenue. This new right turn curve would require additional street right-of-way from an existing parking lot. Another street modification would be the construction of a 100 foot radius curve at Cedar Street for the southbound traffic to be directed to Tenth Avenue. The intersection between Ninth and Cedar Streets is proposed to contain a traffic diverter to separate arterial traffic from the local residential and park oriented traffic. A large radius double right turn lane is also proposed at Cedar Street and Tenth Avenue to accommodate southbound traffic. South of Cedar Street, it is proposed that Tenth Avenue be widened by 18 feet to the west to provide a 64 foot roadway in accordance with arterial street standard E. This widening would require the relocation of the two City tennis courts. It is also proposed that the roadway adjacent to

the east side of the Library be modified to eliminate access on Maple Street at the intersection with Tenth Avenue and replaced with an access on Tenth Avenue at the new traffic signal serving a shopping center between Maple Street and 13th Avenue.

Additional traffic signals will be required on Tenth Avenue at Washington and Main Streets and on Ninth Avenue at Washington, Baseline, Oak and Walnut Streets. These signals should be interconnected with those on T.V. Hwy., Cornell Road and Oak and Baseline Streets.

#### 216th-219th Avenues

It is recommended that 216th-219th Avenues function as a north-south arterial street between Cornell Road and T.V. Hwy. It should provide one travel lane in each direction with left turn lanes at intersections and major driveways and be designed in accordance with street standard D or 40 feet between curbs. A separate two-way eight foot bike path is proposed on one side of the roadway.

It is further recommended that one intersection with Baseline Road be developed midway between the two existing intersections of 216th and 219th Avenues to provide a simple and safe four way intersection.

It is also recommended that 216th Avenue be relocated south of Cornell Road to cross the railroad tracks and intersect with Cornell Road on the west side of the tracks and opposite Cornelius Pass Road. Therefore, 216th-219th Avenues would be a southerly extension of Cornelius Pass Road and form a continuous north-south arterial street on the east side of Hillsboro. Traffic signals will be required at the intersections with Cornell Road, Baseline Road and T.V. Hwy.

#### Cornelius Pass Road

It is recommended that Cornelius Pass Road be developed into a four lane roadway 64 feet wide in accordance with street standard E. A separate two-way eight foot bikeway is recommended to be located along one side of the roadway extending north from the 216th-219th bikeway and intersecting with the bikeway proposed on Cornell Road.

Traffic signals will be required at the intersections with Cornell Road, Evergreen Road and the Sunset Highway ramp connections.

### South By-Pass

As indicated previously, it is anticipated that Oak and Baseline Streets will function satisfactorily for the next 20 years and that it is not absolutely necessary that an additional road be constructed for through traffic on T.V. Hwy. to by-pass the downtown area.

However, in the event that the existing Southern Pacific Company right-of-way becomes available or that a corridor parallel to the right-of-way becomes available to the City, it is recommended that it be acquired for a future south by-pass. As indicated on Figure 18, the south by-pass could start west of the Dairy Creek and connect back to T.V. Hwy. east of 10th Avenue. If the roadway is constructed in the future, it should be done in accordance with street standard D, providing one travel lane in each direction plus left turn lanes within a 40 foot pavement. A separate two-way eight foot bikeway should then be constructed adjacent to the roadway.

### County Roads

County arterial roadways which connect to Hillsboro include Glencoe Road, Jackson Road and Shute Road north of Evergreen Road and Cornell and Baseline Roads east of 216th Avenue.

Cornell Road should be developed as a four lane County arterial in accordance with the County road standard. Glencoe, Jackson, Shute and Baseline Roads are recommended to be developed as two lane roadways in accordance with the County road standard for a two lane arterial.

- Collector Streets

Lennox Street

It is recommended that a new east-west residential collector street 36 feet wide be constructed from Jackson School Road to 15th Avenue and between Evergreen Road and Sunrise Lane at about Lennox Street. This street should be constructed in accordance with street standard C.

Pomeroy Street

It is proposed that a new east-west industrial street be developed between 15th and 25th Avenues on the south side of the industrial area south of Evergreen Road. This street should be constructed 40 feet wide in accordance with street standard D.

### Airport Road

It is recommended that Airport Road be developed as an industrial street and form a loop between 268th and Evergreen Road to approximately 224th and Evergreen Road. This road should be designed 44 feet wide in accordance with street standard D-1 to provide two travel lanes, two bike lanes and one parking lane.

### Butler Street

It is recommended that Butler Street be developed into an industrial street between the northerly extension of Brookwood Avenue to the southeast corner of Airport Road as shown on Figure 18. At the intersection with Brookwood Avenue, it should follow the approximate alignment of existing Airport Road to Butler Street. This roadway should be designed 44 feet wide in accordance with street standard D-1 to accommodate two bike lanes.

### Sunrise Lane

It is recommended that Sunrise Lane be constructed 36 feet wide in accordance with standard C between Jackson School Road and 17th Avenue to match the section east of 17th

Avenue. Sunrise Lane would function as a residential collector street.

#### Arrington Road

Arrington Road is a residential collector street 36 feet wide between Jackson School and Cornell Roads. Its only modification is required at the intersection with Cornell Road to intersect more at a right angle than at present.

#### Grant Street

Grant Street is a residential collector street varying in width between 20 and 44 feet between First and 29th Avenues. It is recommended that it be widened from 20 to 40 feet in accordance with street standard C-1 between 6th Avenue and Delsey Road. It is further recommended that bike lanes be provided in the roadway throughout the entire length of Grant Street. An additional traffic signal will be required on Grant Street at First Avenue.

#### Garibaldi Street

It is recommended that Garibaldi Street be widened to 36 feet in accordance with street standard C to function as a





residential collector street between First and NW 317th Avenues. Railroad gates will be required at the grade crossing of the tracks.

#### Jackson Street

Jackson Street functions as a residential collector street and should be widened to 36 feet in accordance with street standard C between Connell and NW 317th Avenues.

#### Brogden Street

It is recommended that Brogden Street be widened to 36 feet in accordance with street standard C between 29th Avenue and the proposed northerly extension of Brookwood Avenue. This street functions as a residential collector.

#### West Main Street

It is recommended that West Main Street be developed as a collector street 44 feet wide in accordance with street standard D-1 between Oak Street and the S.P.C. tracks one block west of First Avenue. Bike lanes on each side of the street within the pavement plus one parking lane are recom-

mended on this section of Main Street to First Avenue. A traffic signal will be required at First Avenue.

#### East Main Street

East Main Street should function as a one-way westbound collector street between Ninth and First Avenues. Its existing street width of 36 feet is sufficient to accommodate the future traffic. It is recommended, however, that parking be replaced on the north side of the street with a bike lane as far west into downtown as possible. A new traffic signal will be required at the intersection with Fifth Avenue and should be interconnected with the other signals in the downtown area to provide progression of traffic flow on all the streets.

#### Washington Street

It is recommended that Washington Street function as a one-way eastbound collector street between First and Ninth Avenues. The existing 36 foot street width is sufficient to accommodate the projected traffic volume. As with East Main Street, a bike lane is recommended on one side of Washington Street east of First Avenue and would replace

a curb parking lane. Traffic signals will be required at the intersections of First, Second, Third, Fourth, Fifth, Ninth and Tenth Avenues and should be inter-connected with the other signals in the downtown area.

#### Cedar Street

It is recommended that Cedar Street be developed as a residential collector street between 32nd and Brookwood Avenue. The roadway should be 36 feet wide in accordance with street standard C.

#### Maple Street

It is recommended that Maple Street function as a residential collector street between Tenth Avenue and 24th Avenue and be developed with a pavement width of 40 feet in accordance with street standard C-1. Currently, the pavement varies between 19.5 and 36 feet. It is recommended that two travel lanes, two bike lanes and one parking lane be provided on this section of roadway.

Bentley Road

It is recommended that Bentley Road be developed as a residential collector street 36 feet wide in accordance with street standard C between 32nd and Brookwood Avenues.

Lois Street

It is recommended that Lois Street be developed as a residential collector street 36 feet wide in accordance with street standard C between 219th and 239th Avenues.

Francis Street

It is recommended that Francis Street be developed as a residential collector street with bike lanes between 219th and 239th Avenues. The pavement width should be 40 feet in accordance with street standard C-1.

Cypress Street

It is recommended that Cypress Street function as a collector street between T.V. Highway and its connection to 32nd Avenue. It is further recommended that bike lanes be provided within the roadway on the south side of the street for

eastbound bike travel. For westbound bike travel it is recommended that the existing eight foot combination bikeway and sidewalk on the north side of existing Cypress Street be continued to T. V. Highway.

Currently, Cypress is 40 feet wide between 32nd Avenue and approximately 24th Avenue. It is recommended that Cypress Street be extended southwesterly to intersect with T. V. Hwy. opposite Minter Bridge Road and that 21st Avenue be relocated to intersect with Cypress Street north of T. V. Hwy. The new section of Cypress Street should be constructed 40 feet wide in accordance with street standard D to provide two travel lanes, one bike lane and one curb parking lane. At the intersection with T. V. Hwy., Cypress Street should contain one southbound lane, one left turn lane, one northbound lane and one four foot bike lane on the east side and one eight foot combination sidewalk bikeway on the west side. The existing 40 foot section of Cypress Street east of 24th Avenue should be striped to match the section recommended west of 24th Avenue.

#### Golden Road

It is proposed that Golden Road be developed as a residential collector street with bike lanes between 239th and Brookwood Avenues. The pavement width should be 40 feet in accordance

with street standard C-1. The alignment of Golden Road will have to be modified slightly at the intersection with Brookwood Avenue. The right angle curve on Brookwood Avenue is proposed to be made into a smooth curve necessitating the intersection with Golden Road to be realigned at a right angle.

#### Witch Hazel Road

It is recommended that Witch Hazel Road be developed as a collector street 40 feet wide in accordance with street standard D between River Road and T. V. Hwy. The existing intersection with T. V. Hwy. should be relocated to the west opposite Brookwood Avenue if Witch Hazel School is closed.

#### River Road

It is recommended that River Road function as a two lane collector. It currently is 40 feet wide and striped for two lanes plus a two-way left turn lane between T. V. Hwy. and approximately 400 feet west of Rock Creek. East of this point it is a two lane 26 foot roadway. It is recommended that it be widened to 40 feet to the intersection

with Witch Hazel Road. East of Witch Hazel Road, it is a County Road and should be maintained to County standards for a rural collector road.

#### Hornecker Road

It is recommended that Hornecker Road be developed as a residential collector 36 feet in accordance with Washington County standards between Padgett Road and Connell Avenue. West of Padgett Road, Hornecker Road should be maintained as a County collector roadway.

#### NW 317th Avenue

It is recommended that NW 317th Avenue function as a residential collector street and be improved to 36 feet wide in accordance with street standard C between Garibaldi Street and the connection with West Main Street.

#### NW Tenth Avenue

NW Tenth Avenue functions as a residential collector street. It should be improved to a 36 foot street in accordance with

street standard C between Padgett Road and Garibaldi Street.

#### Connell Avenue

Connell Avenue functions as a residential collector street between Glencoe Road and West Main Street. It varies in width between 22 and 40 feet. It is recommended to be widened to 40 feet throughout its entire length in accordance with street standard C-1. It is further recommended to provide two travel lanes, two bike lanes and one curb parking lane. Figure 23 indicates a suggested design for the intersection with Glencoe Road.

#### Jackson School Road-Fifth Avenue

It is recommended that Jackson School Road and Fifth Avenue function as a north-south collector street between Oak and Evergreen Streets. North of Grant Street it should be widened to 44 feet in accordance with street standard D-1 to provide two travel lanes, two bike lanes and one curb parking lane. It is further recommended to modify the intersection complex formed by Jackson School Road, Fifth Avenue and Grant Street to simplify the traffic movements and reduce a potential accident hazard. The modification should consist of either eliminating Jackson School Road



121

1"=100'

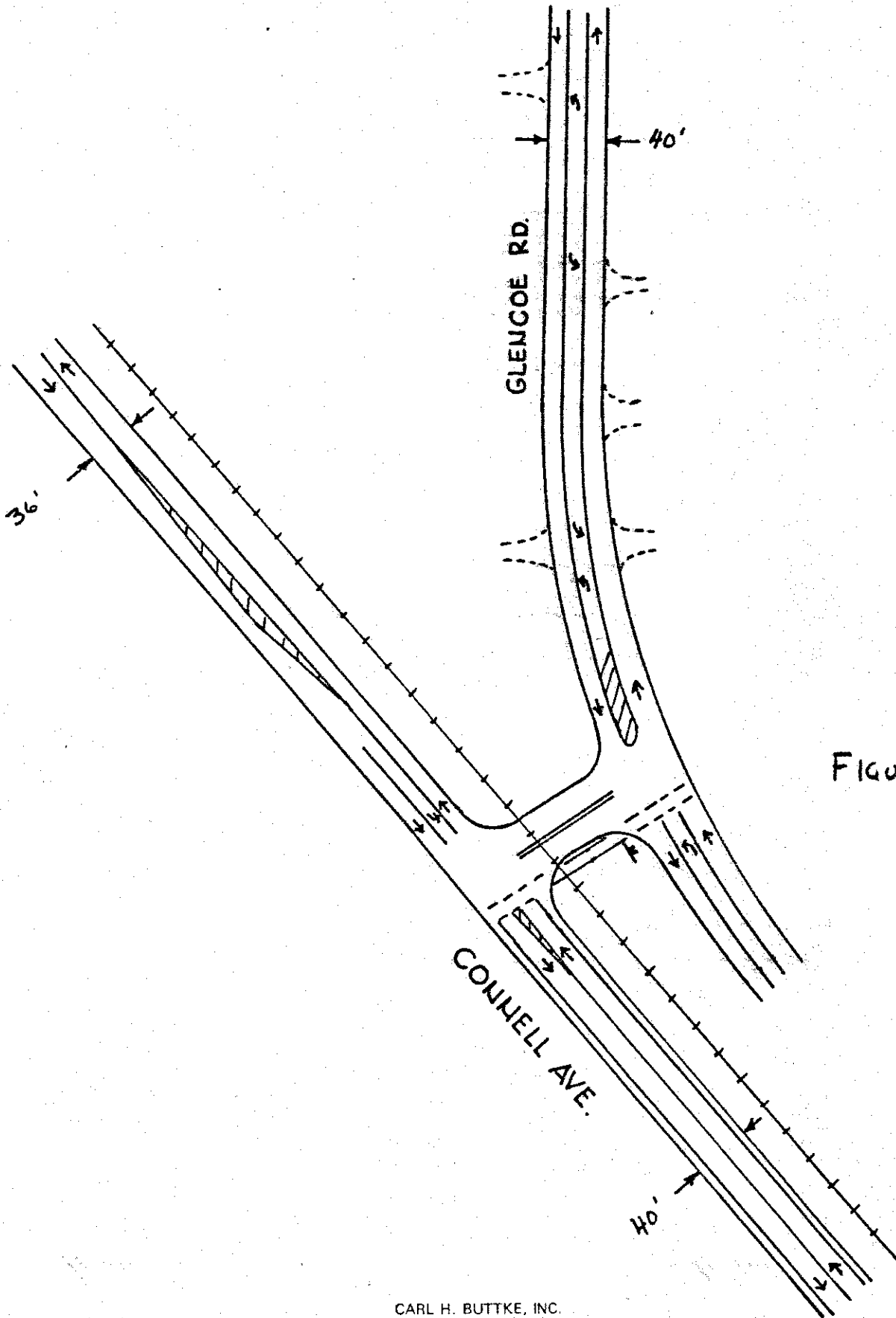


FIGURE 23

between Fifth Avenue and Grant Street or changing it to a one-way southbound roadway. Therefore, the major turning movements would be accommodated at only one location--Fifth Avenue and Grant Street.

Additional traffic signals are recommended at Jackson School Road and Evergreen Road and on Fifth Avenue at Main and Washington Streets.

#### 13th Avenue

It is recommended that 13th Avenue be developed as a residential collector street 36 feet wide in accordance with street standard C between T.V. Hwy. and Maple Street. At the signalized intersection with T.V. Hwy., it should be widened slightly to 40 feet to accommodate one southbound lane, one left turn lane and one northbound lane.

#### 15th Avenue

It is recommended that 15th Avenue (also 281st Avenue) be developed as a collector street 40 feet wide between Evergreen Road and Sunrise Lane. It should be designed in accordance with street standard D.

17th Avenue

It is proposed that 17th Avenue function as a residential collector street between Cornell Road and Sunrise Lane. It should be designed as a 36 feet roadway in accordance with street standard C.

Minter Bridge Road

Minter Bridge Road currently functions as a collector street. It varies in width between approximately 22 feet and 41 feet. It is recommended that the existing section of roadway 22 feet wide between Morgan Road and the City Limit line approximately 600 feet south of River Road be widened to 40 feet in accordance with street standard D. South of Morgan Road, it should be maintained as a County rural collector roadway.

21st Avenue

It is recommended that 21st Avenue be developed as a residential collector street between the proposed intersection with Cypress Street and Maple Street. It should be constructed 36 feet wide in accordance with street standard C.

### 24th Avenue

It is recommended that 24th Avenue function as a residential collector street between Maple and Main Streets to complete the collector street system south of Main Street between 10th and 24th Avenues. 24th Avenue should be constructed 36 feet wide in accordance with street standard C.

### 25th-28th Avenues

It is recommended that 25th and 28th Avenues be joined together to function as one north-south collector street between Evergreen and Main Streets. It should be constructed 44 feet wide in accordance with street standard D-1 to accommodate two travel lanes, two bike lanes and one curb parking lane. Figure 24 indicates the suggested design of the intersection between 25th, 28th and Cornell Roads.

Traffic signals and left turn lanes will be required at the intersections with Evergreen Road , Cornell Road and Main Street.

### Rood Bridge Road

It is recommended that Rood Bridge Road be developed as a

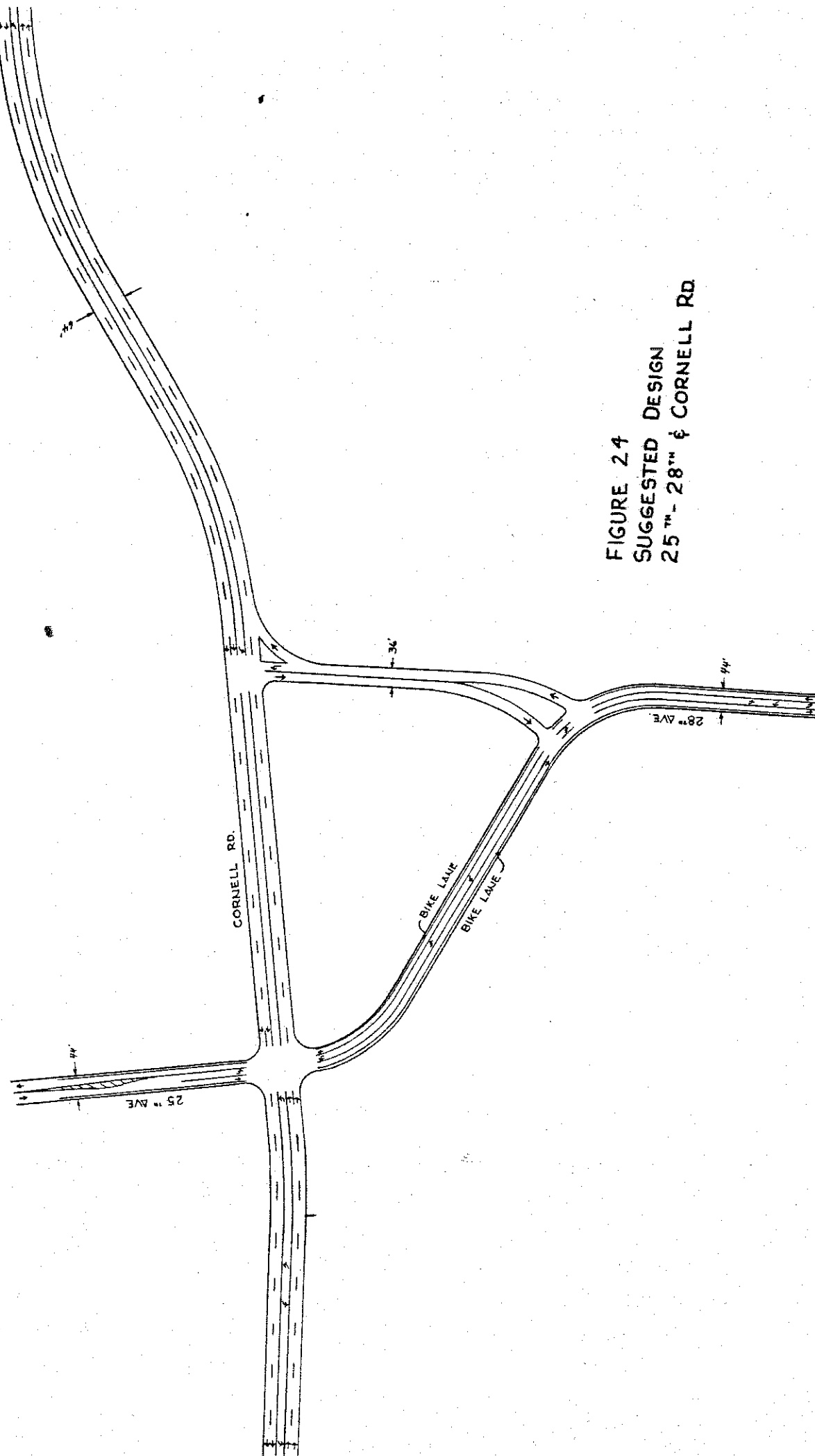


FIGURE 24  
SUGGESTED DESIGN  
25<sup>TH</sup> - 28<sup>TH</sup> & CORNELL RD



residential collector street between Hillsboro Senior High School and the Tualatin River. It should be constructed 36 feet wide in accordance with street standard C. A separate eight foot combination bikeway and sidewalk should be provided on the west side of the roadway between River Road and the High School.

#### 32nd Avenue

It is recommended that 32nd Avenue be designed to function as a collector street with bike lanes between its connection with Cypress and Main Streets. It should be constructed 44 feet wide in accordance with street standard D-1. A traffic signal and left turn lane will be required at the intersection with Main Street.

#### 37th Avenue

It is recommended that 37th Avenue be developed as a residential collector street between Main and Brogden Streets. It should be constructed 36 feet wide in accordance with street standard C.

#### Brookwood Avenue

It is recommended that Brookwood Avenue be developed as

a north-south collector street between T.V. Hwy. and Evergreen Street. To accomplish this, it should be extended northerly on a new alignment from Main Street to Evergreen Street as shown on Figure 18.

It is recommended to be designed 44 feet wide in accordance with street standard D-1 to accommodate two travel lanes, two bike lanes and one curb parking lane.

The existing right angle turn in the vicinity of the intersection with Golden Road is recommended to be improved by developing a larger radius to the curve of approximately 250-300 feet.

Traffic signals and left turn lanes will be required at the intersections with T.V. Hwy., Main Street and Cornell Road.

#### Shute Road

It is recommended that Shute Road be developed as a collector street between Evergreen Street and Cornell Road. It should be constructed 40 feet wide in accordance with street standard D. However, in lieu of a five foot sidewalk on one side of the street, it is recommended that a separate two-way eight foot bikeway be installed between Evergreen Road and Cornell Road.

239th Avenue

It is recommended that 239th Avenue be developed as a residential collector street between T.V. Hwy. and Lois Street. Bike lanes within the roadway are recommended between T.V. Hwy. and Francis Street. Therefore, a 40 foot roadway developed in accordance with street standard C-1 is recommended between T.V. Hwy. and Francis Street. A 36 foot roadway in accordance with street standard C is recommended between Francis and Lois Streets.

231st Avenue

It is recommended that 231st Avenue be developed as a collector street with bike lanes between Main and Butler Streets. A 44 foot roadway is recommended in accordance with street standard D-1. Traffic signals will be required at the intersections with Main Street and Cornell Road.

## BIKEWAYS

A bikeway system for the City has been suggested and is shown on Figure 25. It is a system designed to accommodate the various needs of cyclists, including commuting, recreation travel and general riding by children.

There are three categories of bikeways and are described as follows: <sup>1</sup>

Class I Bikeway--A bikeway completely separated from vehicular traffic and within an independent right-of-way or the right-of-way of another facility. Bikeways separated from vehicles but shared by both bicycles and pedestrians are included in the classification.

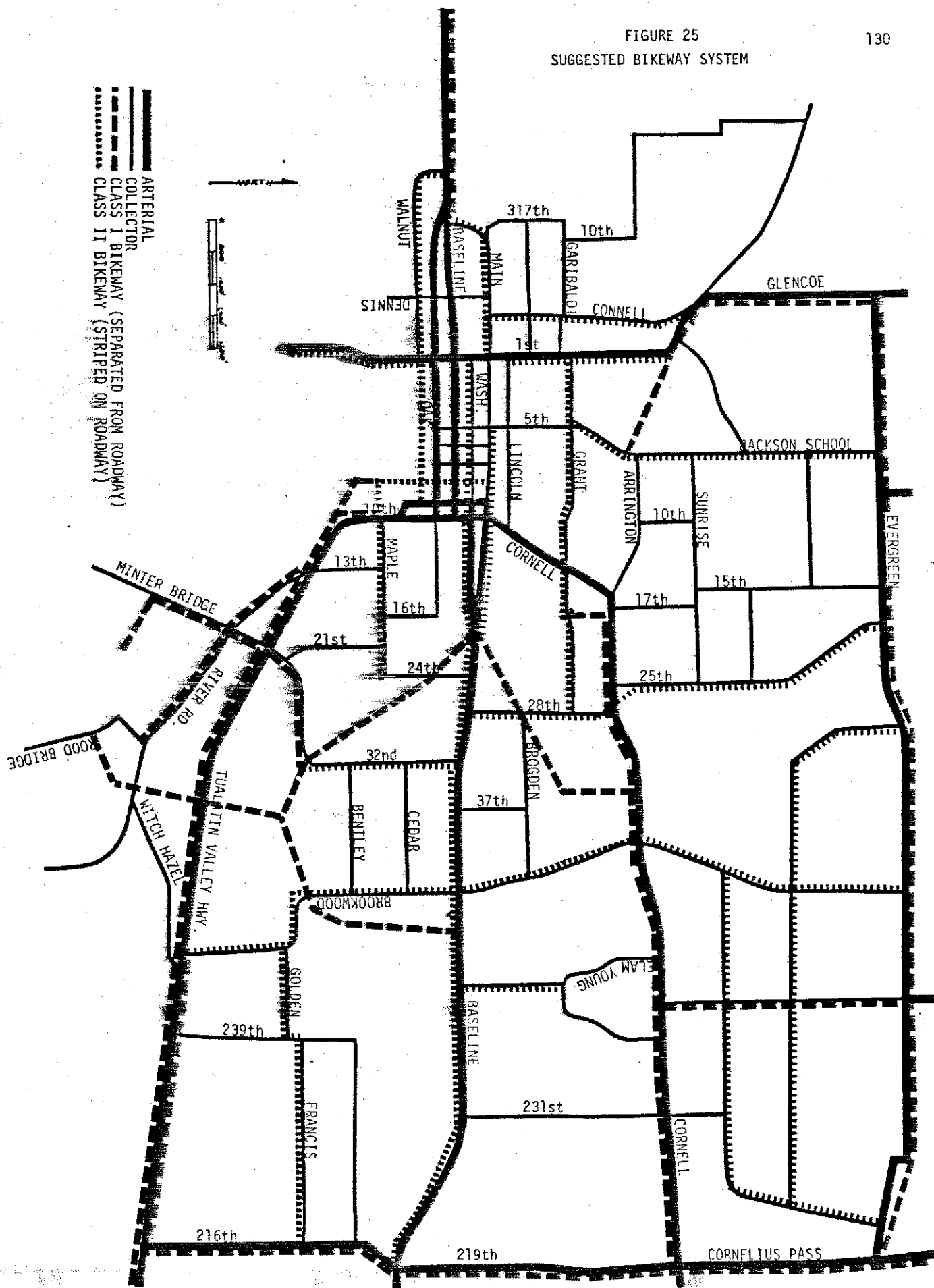
Class II Bikeways--Any bikeway which is part of the roadway or shoulder and delineated by pavement markings or barriers such as extruded curb or pavement bumper blocks. Vehicle parking, crossing or turning movements may be permitted within the bikeway.

Class III Bikeways--Any bikeway sharing its traffic right-of way with motor vehicles and designated by signing only.

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<sup>1</sup> A bikeway Criteria Digest - The ABCD's of Bikeways, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C.

FIGURE 25  
SUGGESTED BIKEWAY SYSTEM



The suggested bikeway system consists of Class I and II bikeways. Class I bikeways are two-way eight feet wide and are located either on its exclusive right-of-way within a greenway, flood plain or the old Burlington Northern right-of-way, or located along side an arterial or collector where there are few driveways or intersection conflicts. The Class I bikeway adjacent to the arterials would also be shared with pedestrians.

Sidewalk bikeways have been found to have various degrees of success. Unsatisfactory experience has been reported for the following reasons:

- Poor sight distance often prevails at driveways.
- Poor visual relationship between cyclist and motorist occurs at intersections.
- Bi-directional operations compound sight distance/visual relationship problems.
- Sharing space with pedestrians creates increasing conflicts from small children at play to older pedestrians becoming uneasy meeting cyclists along the bikeway."

A sidewalk bikeway also is not very conducive to the serious cyclist or commuter because of the number of

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<sup>1</sup>Ibid.

intersection crossings, pedestrian conflicts and small radius turns. The commuter on a bicycle generally travels as fast as possible and would prefer the street to the sidewalk on which to ride.

Therefore, when a Class I bikeway cannot be located in areas generally free of driveways, pedestrian conflicts and intersections, it is recommended that it be designed as a Class II bikeway. The recommended street standards shown on Figure 17 indicate the location and width of Class II bikeways on the different type of streets. In all cases, the bikeway is one-way and operates in the same direction as the motor vehicle traffic. More detailed engineering is required for the actual design, striping, marking and signing of the proposed bikeways. Conflicts between turning vehicles, bus stops and parking vehicles must be resolved in the design stage.

#### PUBLIC TRANSPORTATION

Public transportation service for the area is provided by TRI-MET. Plans for future service are currently being developed by both TRI-MET and the Metropolitan Service District. These plans include either the development of

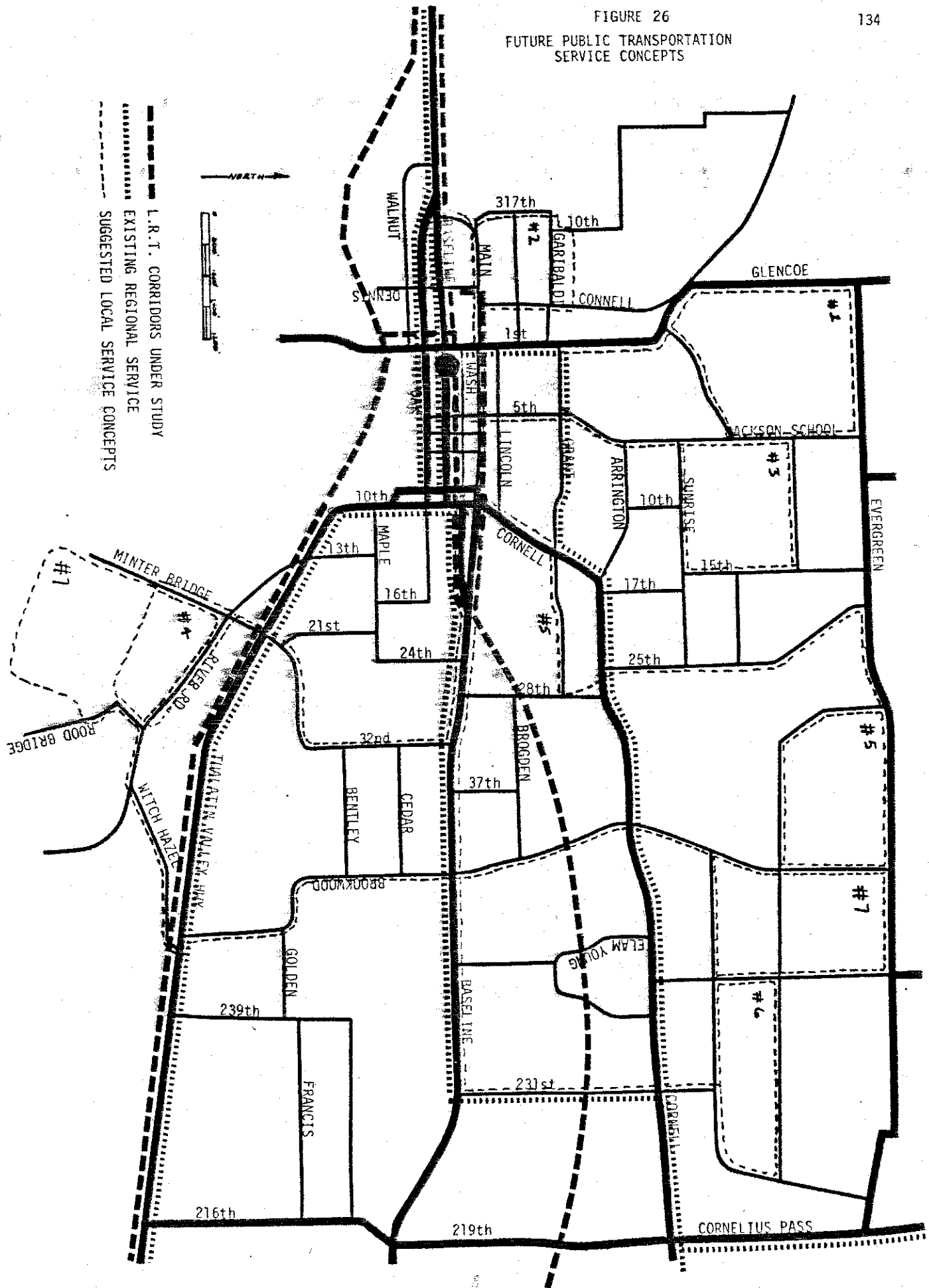
a light rail system into Hillsboro or an express bus system connecting Hillsboro to Beaverton and Portland. The choice of corridor location and vehicle type will not be made for at least one more year. It is further anticipated that if light rail were developed, it probably would not be operational to Hillsboro until after 1990 or 1995. Figure 26 indicates the two possible corridors for a light rail system route into Hillsboro.

In the meantime, it is recommended that the existing transit service be expanded to include local service radiating from the downtown, some cross town service in the north-south direction with transfer points on the regional east-west lines and expanded regional east-west service connecting to cities to the east and west. An example of local service both radiating from the downtown and north-south cross-town service is also shown on Figure 26.

It is recommended that the City develop a policy covering public transportation such that the City be provided with public transportation service so every resident and worker is within a two to three block walk from a bus or light rail stop.

It is further recommended that the City's land use policy also reinforce public transportation service by locating

FIGURE 26  
FUTURE PUBLIC TRANSPORTATION  
SERVICE CONCEPTS



or clustering high density residential areas within walking distance of existing or potential transit lines, especially light rail lines or stations.

Also, the clustering of high density residential uses in close proximity to high employment areas would reinforce transit service since both residential and employment centers could be served at one location.

A central bus transfer station is recommended in the downtown area where people would transfer from local service to regional service. The City owned parcel on the southeast corner of Second Avenue and Washington Street would function well as a transfer station for buses. It is recommended that this site be analyzed in more detail to be utilized for an expanded transit operation.

It is recommended that park-and-ride stations not be developed within the central portion of the City because of the traffic generation and parking requirements and because local transit service should be provided for this distribution function between homes, jobs and the regional transit lines.

However, it can be expected that people will drive to a major transit trunk line, whether express bus or light rail, from areas outside the City and especially from the north. To cope with this situation, a park-and-ride facility would

best function along 216th-219th Avenue at the transit line.

To help minimize the need for major street widenings and to provide alternative transportation to the residents and employees of Hillsboro, it is recommended that the City support the development of a regional light rail system or express bus system. It is through expanded regional and local transit service that the street width requirements can be maintained as recommended in this plan.

For example, East Main Street is forecast to carry between 14,000 and 22,000 vehicles per day by the year 2000. This is the break point between a three lane and a five lane roadway. A three lane roadway is recommended on the assumption of increased transit service. In the event that a higher level of service is implemented than what was assumed in this analysis, such as a light rail system, then the forecast volume on major east-west arterials could be lower by the year 2000 than shown in this plan. A high capacity light rail system would assure that Main Street could function adequately as a three lane roadway. However, it probably would not minimize the street requirements for T. V. Hwy. or Cornell Road because those roads are already carrying traffic to warrant four lanes plus left turn lanes and because such a high capacity system is more than ten years from being operational in Hillsboro. Therefore, it is

expected that East Main Street and Baseline Road and Oak and Baseline Streets in downtown Hillsboro would benefit the most from a high capacity transit system.

It is also recommended that the City develop a policy on the possible location of a future light rail line in Hillsboro. The two corridors suggested have been the Burnlington Northern Railroad corridor and the T. V. Hwy. or Southern Pacific Company corridor.

The Burnlington Northern corridor is most central to the City and connects to many employment centers in the City and to Beaverton. However, it would be very disruptive in the central part of the City. The T. V. Hwy. corridor would be the least disruptive but also would serve directly a smaller number of employment centers. It is recommended that the City and TRI-MET work together on the choice of this corridor.

## TRUCK ROUTES

Truck routes are intended to serve truck traffic passing through the City or entering and leaving the City without adversely affecting the residential and commercial neighborhoods. The current truck route system is limited to the existing arterials in the City.

It is recommended that this system be maintained and expanded as other arterial streets are constructed. It is also recommended that three collector streets be added to the truck route system. These are 25th Avenue between Evergreen Road and Cornell Road, Shute Road north of Cornell Road and 231st Avenue between East Main and Butler Streets.

It is recommended that the truck routes be signed with the standard truck route sign. In addition, the following streets should be signed to prohibit truck traffic: Sunrise Lane, Arrington Road, Grant Street, Lincoln Street, Maple Street, Cypress Street-32nd Avenue and Brookwood Avenue south of Cornell Road. These truck prohibitions are recommended to reduce the possibility of truck traffic cutting through residential neighborhoods. However, trucks serving the City would be permitted to use any street where there is a truck origin or destination.

## CARPOOLING AND STAGGERED WORK HOURS

It is recommended that the City work with large employers including the County, City Hall and industrial plants and with TRI-MET to organize carpool and vanpool programs. These programs will reduce the need for employee parking and will reduce vehicle trip making in the City.

It is further recommended that the City work with its employers to establish flex time or stagger work hours. The effect of flex time or staggering work hours would be to reduce the traffic volume during peak periods and spread the demand over a greater time period. A successful flex time and staggered work hour program would result in accommodating more traffic on a 24-hour period than without such a program and would provide increased utilization of public transportation vehicles.

## TRANSPORTATION MANAGEMENT TEAM

It is recommended that the City establish a team to manage the City's transportation system. This team should be directed by the City manager's office and consist of representatives of the following departments and agencies:

- City Engineering Department
- City Planning Department
- City Police Department
- City Fire Department
- City Chamber of Commerce
- Washington County
- Oregon Department of Transportation
- TRI-MET
- MSD
- Industrial owners or managers
- Other private sector representatives.

The purpose of this team would be to monitor the City's transportation system, schedule and implement transportation improvements, to develop methods to reduce traffic demand as described in this report and to obtain sources of funding. This team would probably meet once or twice a year as a group to review the past year's experiences and schedule and implement the next year's program.

## IMPLEMENTATION

The implementation of the recommended plan is provided by five priorities. The schedule of improvements has been developed on the basis of need in relationship to the expected growth of the City. This schedule may be modified to reflect the availability of finances.

The first priority represents the next two years, the second priority is before 1985, the third is 1985 to 1990, the fourth priority is beyond 1990 and the fifth priority classifies street improvements which are not needed until the adjacent land develops. Therefore, no timing has been set for the fifth priority as these projects could be implemented at anytime as the adjacent land develops.

### Immediate Priority

- Develop transportation management team
- Develop public transportation policy and seek additional local transit service improvements.
- Change the traffic signal timing at Cornell Road and Grant Street to provide an additional five seconds of green time to Cornell Road.
- Improve the intersection between Cornell Road, Main Street and Tenth Avenue by making the section of

Cornell Road between Tenth and Main Street one-way southbound.

- o Widen Cornell Road between Main Street and Cornelius Pass Road.
- o Improve the intersection between Cornell and Cornelius Pass Roads.
- o Widen Baseline Street west of Dennis Avenue.
- o Realign the intersection between Baseline Road and 216-219th Avenues.
- o Construct Grant Street between Sixth and Delsey Avenues.
- o Construct Cypress Street between T. V. Highway and approximately 24th Avenue.
- o Construct 32nd Avenue between Cypress Street and Main Street. Signalize intersection with Main Street.
- o Construct 17th Avenue between Cornell Road and Sunrise Lane.
- o Signalize the intersection between Brookwood Avenue and T. V. Highway.
- o Improve the intersection between Jackson School Road, Fifth Avenue and Grant Street by making Jackson School Road one-way southbound between Fifth Avenue and Grant Street.

- o Construct Washington Street between Tenth Avenue and the intersection with East Main Street and convert the remaining portion of Washington Street to a one-way eastbound roadway. Signalize the intersections with Ninth and Tenth Avenues. Convert E. Main Street to one-way westbound between the junction with Washington Street and the existing one-way section at Sixth Avenue.
- o Design the Ninth-Tenth Street couplet.
- o Construct Rood Bridge Road between River Road and the High School.
- o Establish access control or restrictions on T. V. Hwy.
- o Establish carpool, vanpool and staggered work hours programs.

#### Before 1985

- o Expand public transportation service into and throughout Hillsboro.
- o Develop downtown transit station.
- o Construct Evergreen Road between Glencoe and Cornelius Pass Roads. Signalize intersection with Cornelius Pass Road.

- o Construct East Main between Tenth Avenue and 216-219th Avenues.
- o Widen to install left turn lanes in T. V. Hwy. and Tenth Avenue from Cedar Street to Minter Bridge Road.
- o Install a traffic signal at the intersection of T. V. Hwy. and 219th Avenue.
- o Construct Jackson School Road between Grant and Evergreen Streets.
- o Install the Ninth-Tenth Avenue one-way couplet system between Cedar and Main Streets.
- o Install new controller in signals on Oak and Baseline Streets.
- o Widen First Avenue and Glencoe Road.
- o Widen Cornelius Pass Road between Cornell Road and Sunset Highway.
- o Improve West Main Street.
- o Construct Brookwood Avenue between T. V. Hwy. and Evergreen Street and install traffic signals at the intersections with East Main Street and Cornell Road.
- o Construct 25th-28th Avenues between Evergreen and Main Streets. Install traffic signal at intersections with Main Street and Cornell Road.

- o Construct 13th Avenue between T. V. Hwy. and Maple Street.
- o Construct 21st Avenue between Cypress and Maple Streets.
- o Construct 24th Avenue between Maple and Main Street.
- o Complete Maple Street between Tenth and 24th Avenues.
- o Construct 231st Avenue between Main Street and Butler Road. Signalize intersections with Main Street and Cornell Road.
- o Construct Witch Hazel and River Roads.
- o Construct Garibaldi Street.
- o Construct Brogden Street.
- o Complete Connell Avenue.
- o Construct Sunrise Lane.
- o Construct bikeways on Greenways and on T. V. Hwy.
- o Expand carpool, vanpool and staggered work hours program.
- o Review transportation planning and growth assumptions to update implementation program.

1985 to 1990

- o Continue to expand public transportation service within the City.
- o Construct 216-219th Avenues between Cornell Road and T. V. Hwy.
- o Construct Minter Bridge Road.
- o Construct the following residential collector streets:

|                |                   |
|----------------|-------------------|
| Jackson Street | N.W. 317th Avenue |
| Cedar Street   | N.W. 10th Avenue  |
| Bently Street  | 37th Avenue       |
| Golden Street  |                   |

After 1990

- o Continue to expand public transportation service.
- o Construct Hornecker Road.
- o Construct other County roads leading into urbanized area, if necessary.

Construction with Adjacent Land Development

- o Airport Road
- o Butler Road
- o Shute Road
- o 15th Avenue
- o Lennox Street
- o Pomeroy Street
- o 239th Avenue and signal at T. V. Hwy.
- o Lois Street
- o Francis Street

## FIVE YEAR CAPITAL IMPROVEMENT PROGRAM

A five year capital improvement program was developed to indicate the current sources of funding, the amount of money required to implement the plan prior to 1985 and to indicate policies which may need to be developed by the City to meet the capital improvement program.

### SOURCES OF FUNDS

Funds to construct and maintain roads in Hillsboro can come from the following sources:

1. Systems development charge
2. State gasoline tax
3. Washington County gasoline tax
4. Federal Aid Urban Systems (FAU)
5. Interstate transfer funds
6. State of Oregon - state highways
7. Washington County - county roads
8. Local improvement district

9. General obligation bonds
10. Adjacent property owners
11. City general fund

#### Systems Development Charge

The City enacted Ordinance No. 2858 to create a systems development charge for the development of extra capacity streets and storm drainage facilities. The purpose of this charge was to create a source of funds to pay for the installation, construction and extension of extra capacity street facilities. Extra capacity street facilities refer to any improvements in excess of those required by ordinance for minimum standard residential streets. The charge is collected at the time property is developed in accordance with the following schedule:

|   |                                    |
|---|------------------------------------|
| Residential Development                   | - \$300 per dwelling unit          |
| Commercial Development                    | - \$125 per required parking space |
| Industrial/Industrial<br>Park Development | - \$50 per required parking space  |

It is estimated that this fund would collect approximately \$5,100,000 between 1979 and the year 2000 as a result of the expected growth in the City. Therefore, the System Development Charge Fund for the next five years is estimated to be \$1,300,000.

### State Gasoline Tax

The City currently receives approximately \$344,000 per year as its share of the State Gasoline Tax collected by the State of Oregon. It is estimated that this tax could account for approximately \$1,460,000 over the next five years.

### Washington County Gasoline Tax

The County has imposed a one cent tax on each gallon of gasoline sold in the County. Hillsboro currently receives approximately \$130,000 per year from this tax. Therefore, over the next five years, it is estimated that the City would receive approximately \$550,000.

### Federal Aid Urban System

The Federal Highway Trust Fund currently funds 17 programs plus a few special purpose programs. The urban system program (FAU) is one source of these funds available to the City for its major roads.

The fund currently provides 88 percent of the roadway cost and the State of Oregon currently provides six percent. Therefore, a local agency would provide only six percent of the cost of a FAU project. However, this fund only has

an allocation of \$272,000 per year for the next eight years to the Portland Metropolitan Area because of state commitments to public transportation in the region and the interstate transfer program.

The FAU funds are appropriated to projects throughout the region by the Metropolitan Service District (MSD) based upon need and regional priorities.

#### Interstate Transfer Funds

Funds for interstate highways I-80N and 505 have been transferred from those projects to other transportation projects in the region. Therefore, those two highways will not be constructed. This fund has provided the region with \$483,600,000 to fund various projects including transit corridor projects in the Banfield Freeway and the westside transitway as well as FAU projects. \$27.1 million have been allocated to FAU projects. However, the region currently has a 20 million dollar reserve fund for other regional roadways currently under consideration for selection. Cornell Road is one of those projects.

The interstate transfer funds will pay for 85 percent of the project cost and the local agency must pay the remaining 15 percent.

### State of Oregon - State Highways

The State of Oregon is responsible for construction and maintenance of the state highways in the City. The state highways include T. V. Highway, Oak and Baseline Streets, 10th Avenue south of Baseline Street and First Avenue south of Baseline Street.

Current policy for the state is to provide only 50 percent of the cost of new traffic signals added to the state highways.

### Washington County - County Roads

Washington County is responsible for the construction and maintenance of county roads connecting to and inside the City. However, the County does not have a capital improvement program and has limited funds for road improvement projects.

### Local Improvement District

Local Improvement Districts (LID) can be formed with the approval of the City Council to construct a roadway. The cost is paid through the sale of bonds which are in turn

paid for by assessments to the lands which benefit from the road improvement project.

#### General Obligation Bonds

General obligation bonds could be sold by the City to pay for road construction. However, a majority vote of the electorate in the City is required to establish the fund which is then repaid through the property tax.

#### Adjacent Property Owners

Street improvement projects are also financed or constructed by the adjacent property owners at the time the land is developed. Generally, all local streets within a subdivision or P.U.D. are paid for and constructed with the project. However, abutting collector and arterial roadways are generally included as part of the development and are required as a condition to project approval. If the land development project is only on one side of a proposed collector or arterial, then that development would be responsible for improving one half the width of that roadway. The landowner would also have the option of a LID to cover the cost of off-site street improvements.

## FIVE YEAR COST ESTIMATES

The cost of all the street improvement projects recommended for development between 1980 and 1985 has been estimated<sup>1</sup> on the basis of 1979 costs. These costs together with an allocation to various sources of funds are provided in Table 10. For allocation purposes it is assumed that the local assessment would be included where unimproved roads are to be improved and that the abutting landowner would be responsible for 50 percent of the cost of one-half the width of a 36 foot street. In other words, the City is assumed to pay for at least 50 percent of the cost of building a street where there is only an unimproved roadway now.

It is estimated that during the next five years, the necessary street improvements will cost \$26,765,000 at 1979 costs. At the current rate of inflation, these costs could double in approximately five years. It is further estimated that the City's share of these costs would be at least \$10,885,000 with the assumption that \$5,037,000 of street construction could be assessed to the adjacent landowners

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<sup>1</sup>Source - City of Hillsboro, Engineering Department.

TABLE 10

## FIVE YEAR CAPITAL IMPROVEMENT PROGRAM

Thousand Dollars in 1979 Value

| Project                                     | Project Cost* | City Share | State Share | County Share | FAU Funds | Local Assess. | Adjacent Dev'l. |
|---|---------------|------------|-------------|--------------|-----------|---------------|-----------------|
| Cornell Rd.-Main to Arrington               | 300           | 300        |             |              |           |               |                 |
| Cornell Rd.-Arrington to Cornelius Pass Rd. | 2,800         | 420        |             |              | 2,380     |               |                 |
| Cornelius Pass Rd.                          | 1,300         |            | 78          | 78           | 1,144     |               |                 |
| Baseline Street                             | 265           |            | 265         |              |           |               |                 |
| Baseline Rd. & 216-219th Ave.               | 250           |            |             | 250          |           |               |                 |
| Grant Street                                | 150           | 75         |             |              |           | 75            |                 |
| Cypress Street                              | 125           | 63         |             |              |           | 62            |                 |
| 17th Ave.                                   | 265           | 133        |             |              |           | 132           |                 |
| Brookwood Ave.                              | 2,365         | 1,332      | 33          |              |           | 400           | 600             |
| Evergreen Road                              | 3,800         | 1,900      |             |              |           |               | 1,900           |
| E. Main St.                                 | 3,200         | 1,260      |             | 1,100        |           | 840           |                 |
| Washington St.                              | 415           | 415        |             |              |           |               |                 |
| T.V. Hwy.                                   | 350           |            | 350         |              |           |               |                 |
| T.V. Hwy. & 219th Ave.                      | 65            |            | 33          | 32           |           |               |                 |
| 9th-10th Couplet                            | 700           | 150        | 550         |              |           |               |                 |
| Oak-Baseline St. Signals                    | 250           |            | 250         |              |           |               |                 |
| First-Glencoe                               | 1,800         | 960        | 200         |              |           | 640           |                 |
| W. Main St.                                 | 450           | 270        |             |              |           | 180           |                 |
| 25th-28th Ave.                              | 1,625         | 775        |             |              |           | 530           | 320             |
| 13th-Main St.                               | 300           | 150        |             |              |           | 150           |                 |
| 21st-Main St.-24th St.                      | 580           | 290        |             |              |           | 290           |                 |
| 32nd Ave.                                   | 470           | 235        |             |              |           | 235           |                 |
| Jackson School Rd.                          | 980           | 360        |             |              |           | 240           | 380             |
| 231st Ave.                                  | 900           |            |             |              |           |               | 900             |
| Witch Hazel                                 | 670           | 402        |             |              |           | 268           |                 |
| Garibaldi                                   | 480           | 240        |             |              |           | 240           |                 |
| Brogden, 37th St.                           | 690           | 345        |             |              |           | 345           |                 |
| Connell St.                                 | 400           | 200        |             |              |           | 200           |                 |
| Sunrise                                     | 420           | 210        |             |              |           | 210           |                 |
| Bikeways                                    | 400           | 400        |             |              |           |               |                 |
| TOTAL                                       | 26,865        | 10,885     | 1,759       | 1,460        | 3,524     | 5,037         | 4,200           |

\*Source: Hillsboro Engineering Department

and that \$4,100,000 of street construction could be accomplished by abutting land developers.

During the next five years the City can expect to receive approximately \$3,310,000 to the street fund as indicated on Table 3. However, the City's budget for its street fund for 1978-80 was approximately \$340,000 for administration, engineering, maintenance and repair. Over the next five years, this cost is expected to total approximately \$2,160,000. Therefore, from present sources of funds, the City is expected to raise \$1,150,000 over the next five years to pay the estimated \$10,885,000 of street construction.

It is concluded that the current sources of funds for streets is not adequate to meet the needs for new construction during the next five years. After 1985, the needs for new construction are much less but the same funds are available. Therefore, a method of borrowing on future funds to construct roads in the near future should be considered.

It is apparent that the system development charge is not sufficient for its intended purpose and that it does not keep up with increasing construction costs. Therefore, the City might consider increasing the system development charge to the street fund by at least two or three times its current charge and to include an annual or bi-annual

TABLE 11

## ESTIMATED FIVE YEAR STREET FUND REVENUE AND EXPENSES

|   |             |
|---|-------------|
| Revenue                                       |             |
| System Development Charge                     | \$1,300,000 |
| State Gasoline Tax                            | 1,460,000   |
| County Gasoline Tax                           | 550,000     |
| Total   | 3,310,000   |
| Budgeted Expenses Without<br>New Construction | 2,160,000   |
| Funds for Construction                        | \$1,150,000 |

increase to match inflation. The City might also explore the possibility of selling revenue bonds for street construction and to use the system development charge as the revenue. Therefore, streets could be constructed at an earlier date with a lower inflation over today's cost estimates.

It is also apparent that the City will have to establish a policy of assessing the abutting landowners to build streets where an unimproved roadway exists. A new building buyer in a subdivision or PUD generally pays half the cost of the street adjacent to the property as part of the cost of the lot plus a system development charge. However, a building owner located on an unimproved street probably never paid to have the road constructed. Therefore, a full assessment to the abutting building owner to pay for one-half the width of a residential street is as equitable as for a new building owner.

The city might wish to utilize a portion of its general fund to offset the assessment, if necessary.

It is recommended that the City establish a policy concerning the amount and portion of off-site street improvements a land-developer would be responsible for at the time of development.

In conclusion, there are many areas of consideration in developing and maintaining an adequate street fund especially when the cost of construction is increasing so rapidly. It is recommended that the City establish a committee composed of homeowners, land-developers, commercial and industrial building-owners, real estate and banking people to formulate a policy for funding streets.

## APPENDIX

TABLE A-1

## YR 2000 DISTRIBUTION OF PRODUCTIONS TO ATTRACTIONS - TOTAL VEHICLE TRIPS

## AVERAGE WEEKDAY VEHICLE TRIP ATTRACTIONS - TRIP ENDS

| ZONE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|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|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|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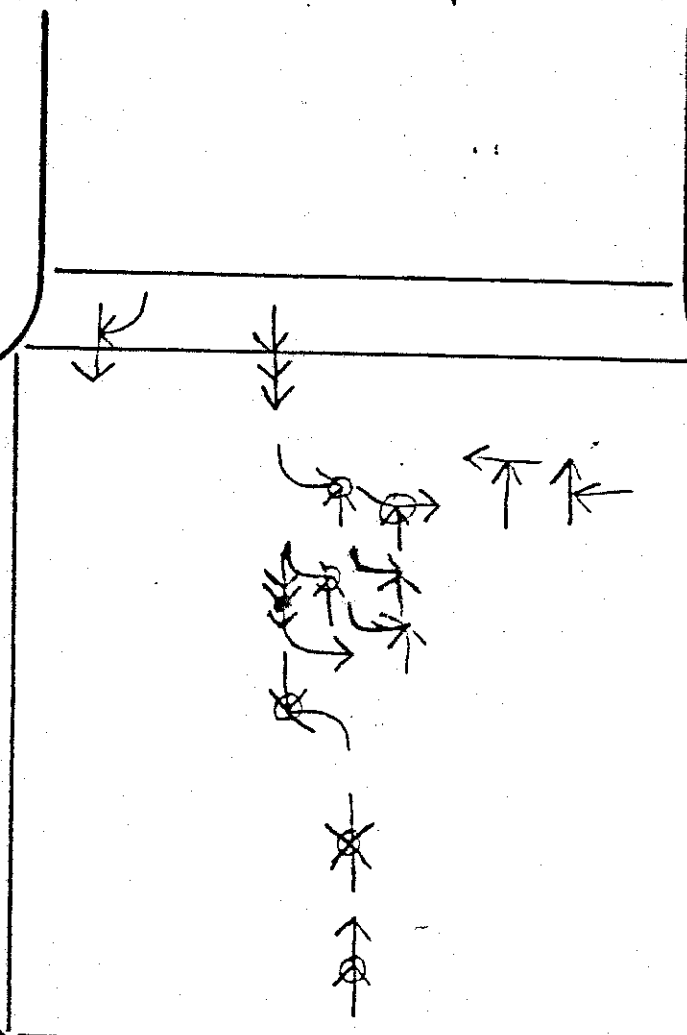
# COLLISION DIAGRAM

INTERSECTION:

SF 10<sup>th</sup> Maple



Name



Name

Maple  
Name

Name

## NUMBER OF ACCIDENTS

9

Property Damage Only

7

Injury or Fatal

16

Total Accidents

- ← Moving Vehicle
- ↔ Backing Vehicle
- ✕ Pedestrian
- ⊗ Bicycle
- ▮ Parked Vehicle
- Fixed Object
- Fatal Accident
- Injury Accident

- ↔ Rear End
- ✕ Head On
- ↔ Side Swipe
- ↔ Out of Control
- ↔ Left Turn
- ↔ Right Angle

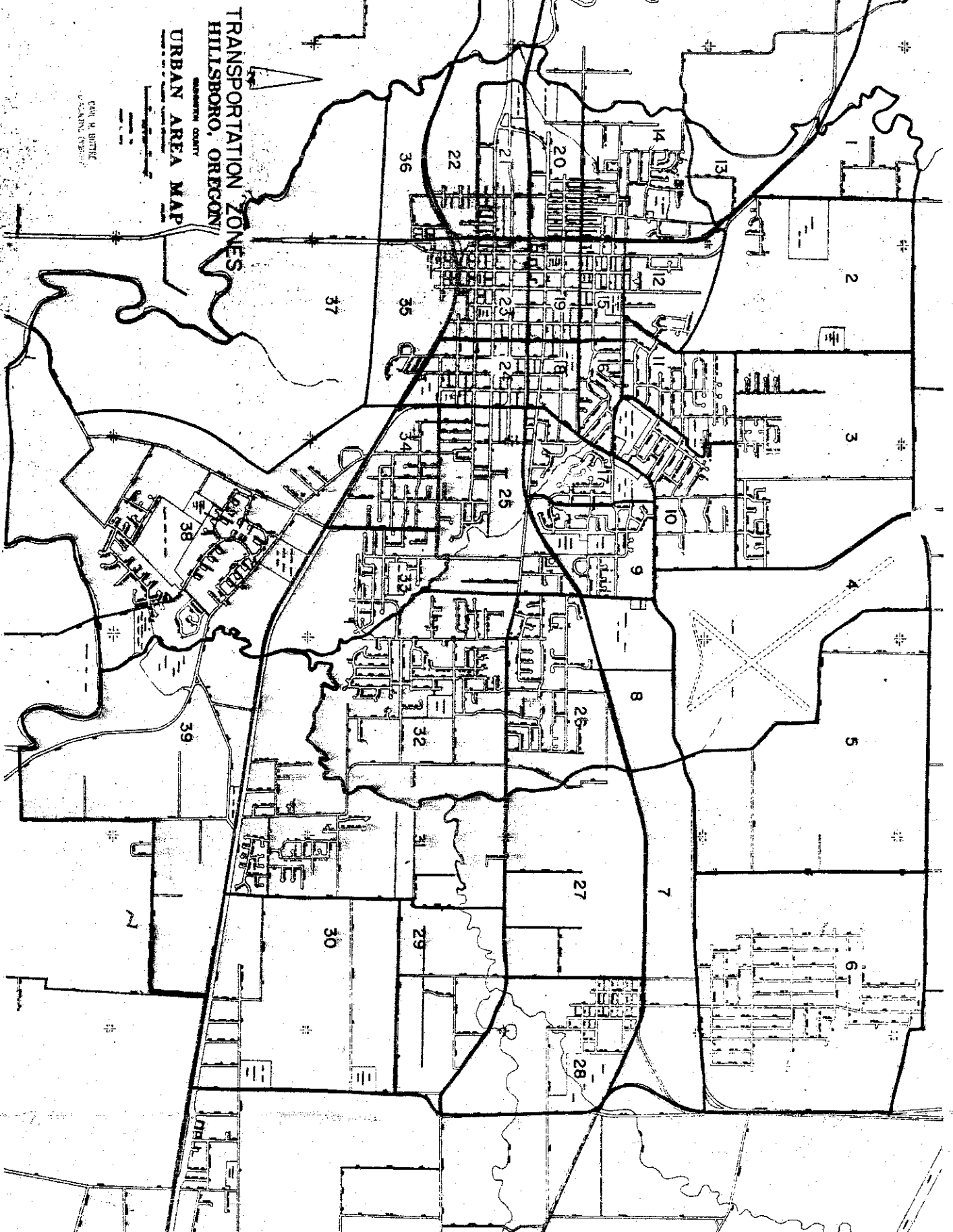
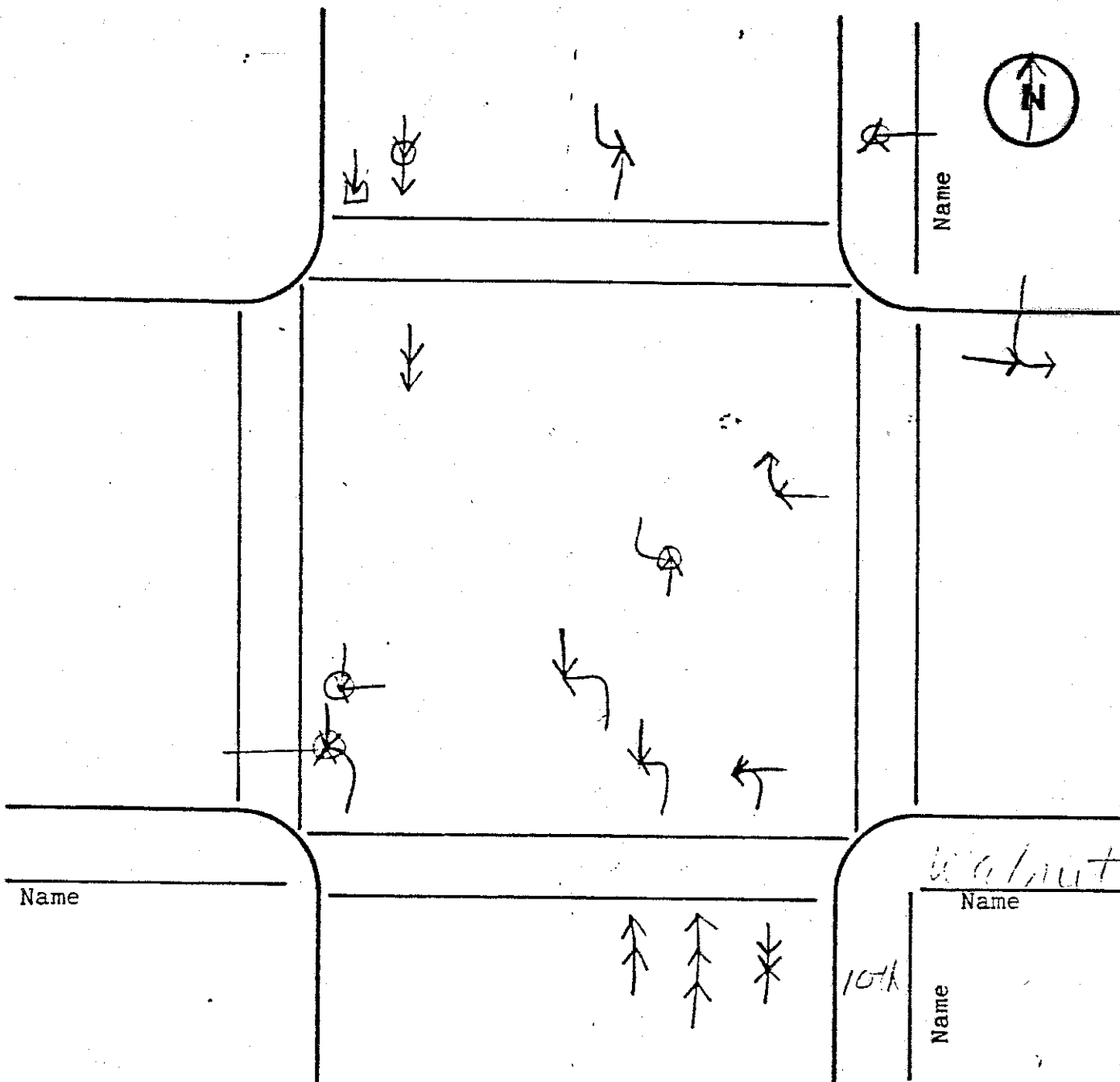


FIGURE A-2

# COLLISION DIAGRAM

INTERSECTION:

S.E. Walnut + 10th

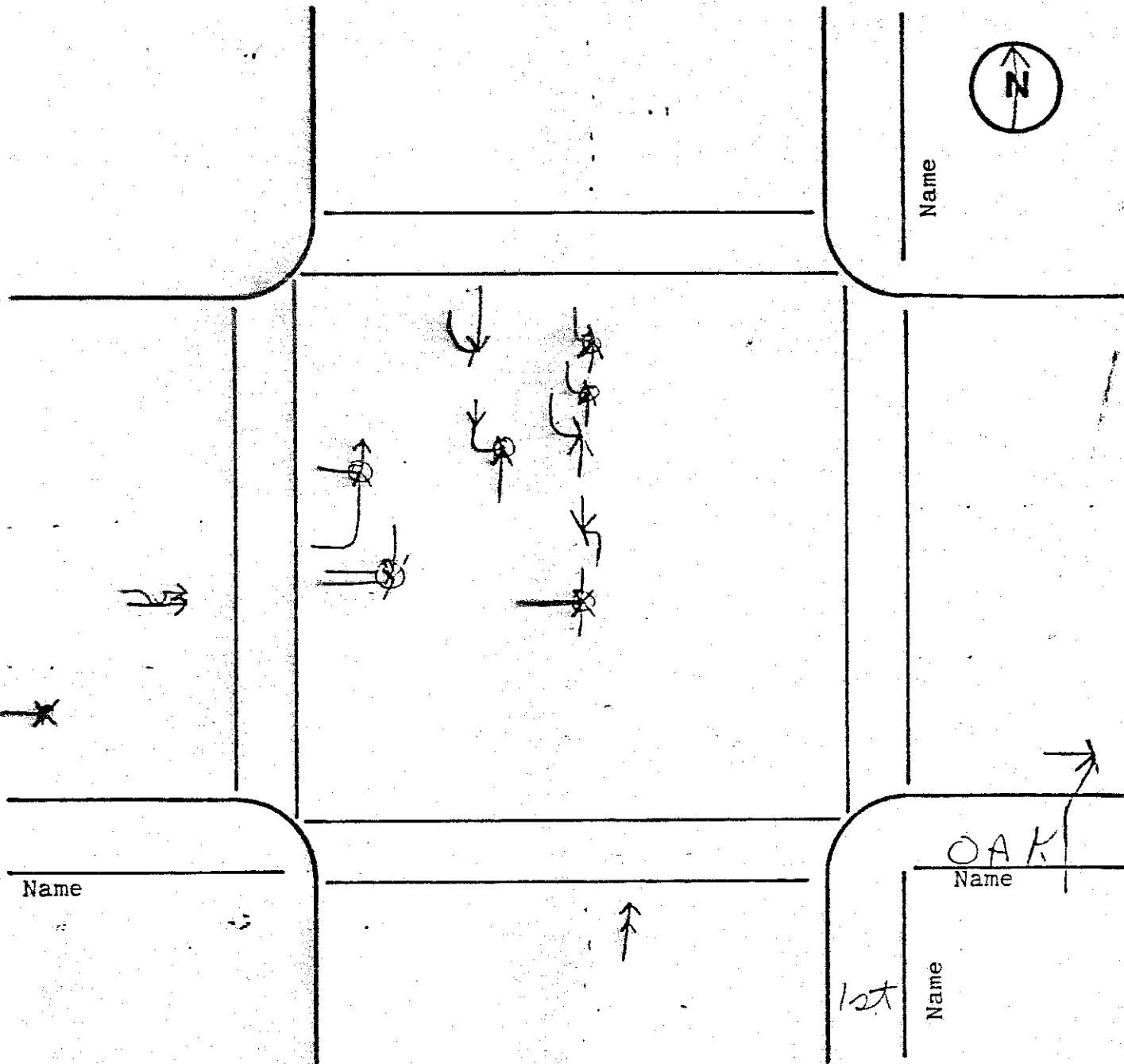


| NUMBER OF ACCIDENTS |                      |    |                 |
|---------------------|----------------------|----|-----------------|
| <u>11</u>           | Property Damage Only | ←  | Moving Vehicle  |
| <u>5</u>            | Injury or Fatal      | ←→ | Backing Vehicle |
| <u>16</u>           | Total Accidents      | X  | Pedestrian      |
|                     |                      | ⊗  | Bicycle         |
|                     |                      | ⊞  | Parked Vehicle  |
|                     |                      | □  | Fixed Object    |
|                     |                      | ●  | Fatal Accident  |
|                     |                      | ○  | Injury Accident |
|                     |                      | ←← | Rear End        |
|                     |                      | ×  | Head On         |
|                     |                      | ←→ | Side Swipe      |
|                     |                      | ←→ | Out of Control  |
|                     |                      | ←  | Left Turn       |
|                     |                      | ↑  | Right Angle     |

# COLLISION DIAGRAM

INTERSECTION:

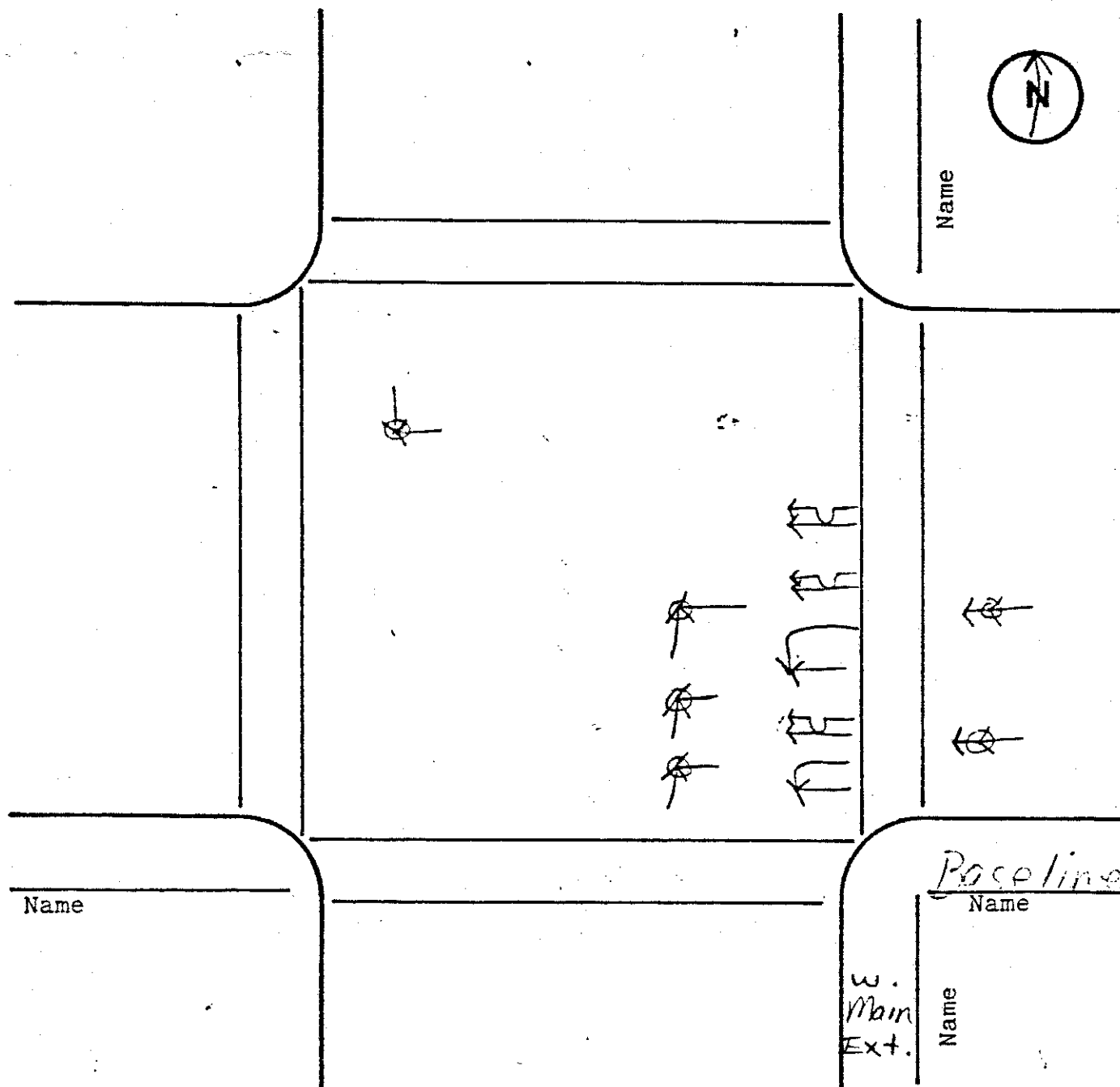
S. W. Oak + 1st



| NUMBER OF ACCIDENTS |                      |                   |                  |
|---------------------|----------------------|-------------------|------------------|
| <u>6</u>            | Property Damage Only | ← Moving Vehicle  | ← Rear End       |
| <u>7</u>            | Injury or Fatal      | ← Backing Vehicle | × Head On        |
| <u>13</u>           | Total Accidents      | × Pedestrian      | ← Side Swipe     |
|                     |                      | ○ Bicycle         | ← Out of Control |
|                     |                      | ▢ Parked Vehicle  | ← Left Turn      |
|                     |                      | □ Fixed Object    | ← Right Angle    |
|                     |                      | ● Fatal Accident  |                  |
|                     |                      | ○ Injury Accident |                  |

# COLLISION DIAGRAM

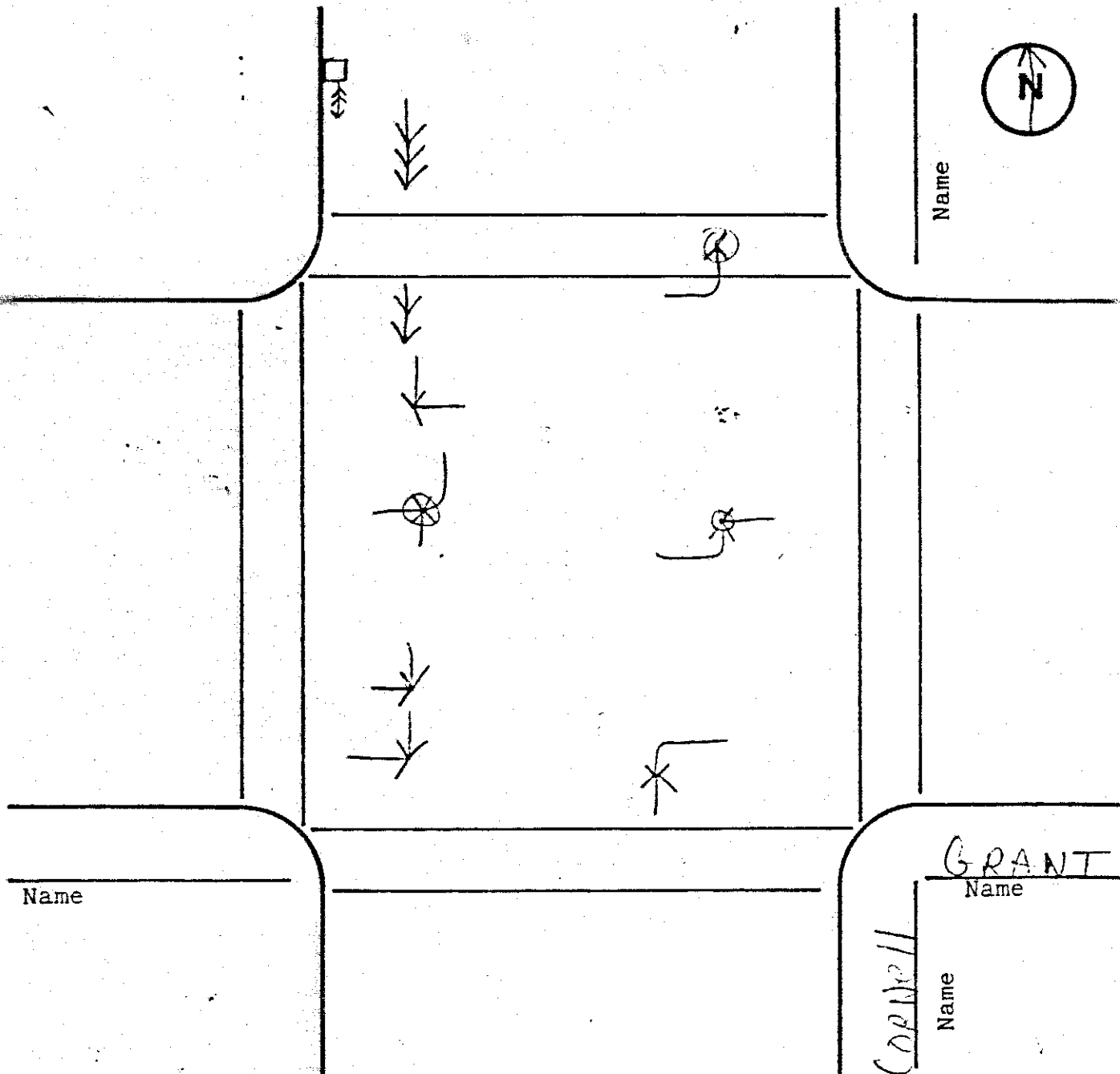
INTERSECTION: West Main Ext. & Baseline



|  |   |   |
|--|---|---|
| <b>NUMBER OF ACCIDENTS</b><br><u>5</u> Property Damage Only<br><u>6</u> Injury or Fatal<br><u>11</u> Total Accidents | ← Moving Vehicle<br>↕ Backing Vehicle<br>X Pedestrian<br>○ Bicycle<br>▭ Parked Vehicle<br>□ Fixed Object<br>● Fatal Accident<br>○ Injury Accident | ↔ Rear End<br>* Head On<br>↔ Side Swipe<br>↗ Out of Control<br>↘ Left Turn<br>↖ Right Angle |
|--|---|---|

# COLLISION DIAGRAM

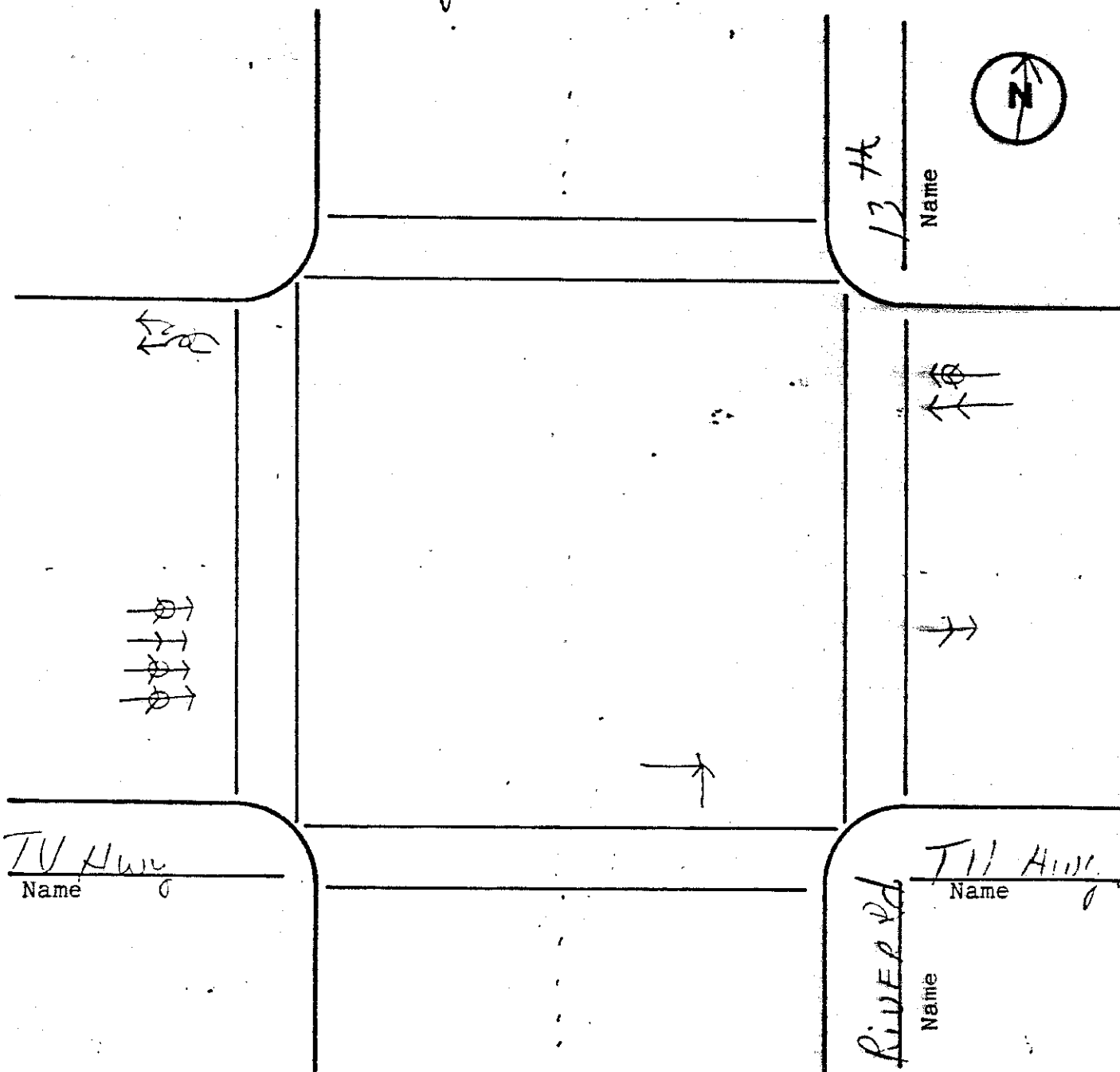
INTERSECTION: N.E. GRANT + CORWELL



| NUMBER OF ACCIDENTS |                      |                   |                  |
|---------------------|----------------------|-------------------|------------------|
| <u>7</u>            | Property Damage Only | ← Moving Vehicle  | ↔ Rear End       |
| <u>3</u>            | Injury or Fatal      | ↔ Backing Vehicle | ✕ Head On        |
| <u>10</u>           | Total Accidents      | ✕ Pedestrian      | ↗ Side Swipe     |
|                     |                      | ⊗ Bicycle         | ↘ Out of Control |
|                     |                      | ▢ Parked Vehicle  | ↖ Left Turn      |
|                     |                      | ▣ Fixed Object    | ↗ Right Angle    |
|                     |                      | ● Fatal Accident  |                  |
|                     |                      | ○ Injury Accident |                  |

# COLLISION DIAGRAM

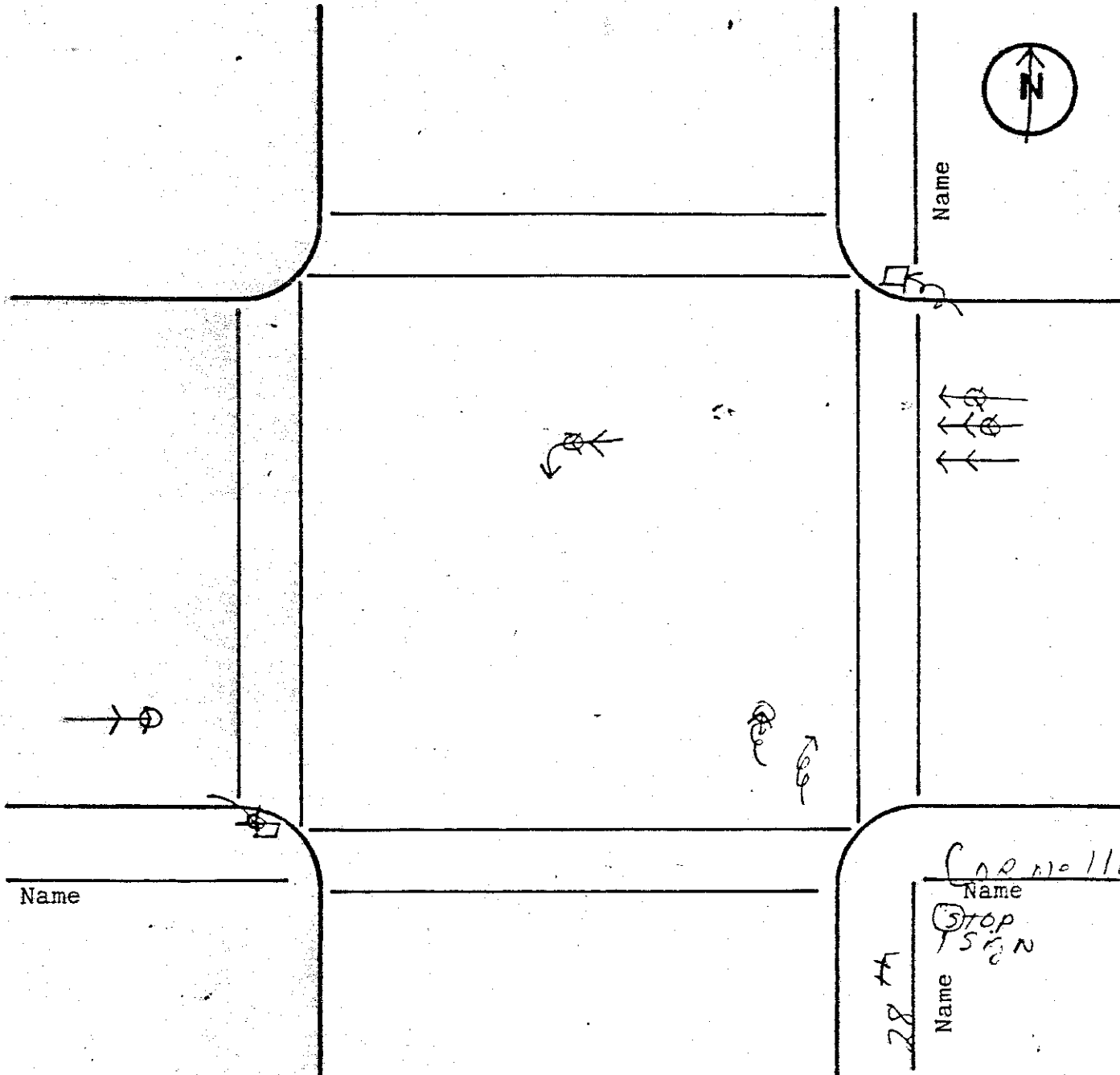
INTERSECTION: S.F. Ttl Hwy + River Rd + 13th



|  |  |  |
|--|--|--|
| <p><u>NUMBER OF ACCIDENTS</u></p> <p><u>5</u> Property Damage Only</p> <p><u>4</u> Injury or Fatal</p> <p><u>9</u> Total Accidents</p> | <p>← Moving Vehicle</p> <p>↔ Backing Vehicle</p> <p>✕ Pedestrian</p> <p>⊗ Bicycle</p> <p>▢ Parked Vehicle</p> <p>□ Fixed Object</p> <p>● Fatal Accident</p> <p>○ Injury Accident</p> | <p>↔ Rear End</p> <p>✕ Head On</p> <p>↔ Side Swipe</p> <p>↔ Out of Control</p> <p>↔ Left Turn</p> <p>↔ Right Angle</p> |
|--|--|--|

# COLLISION DIAGRAM

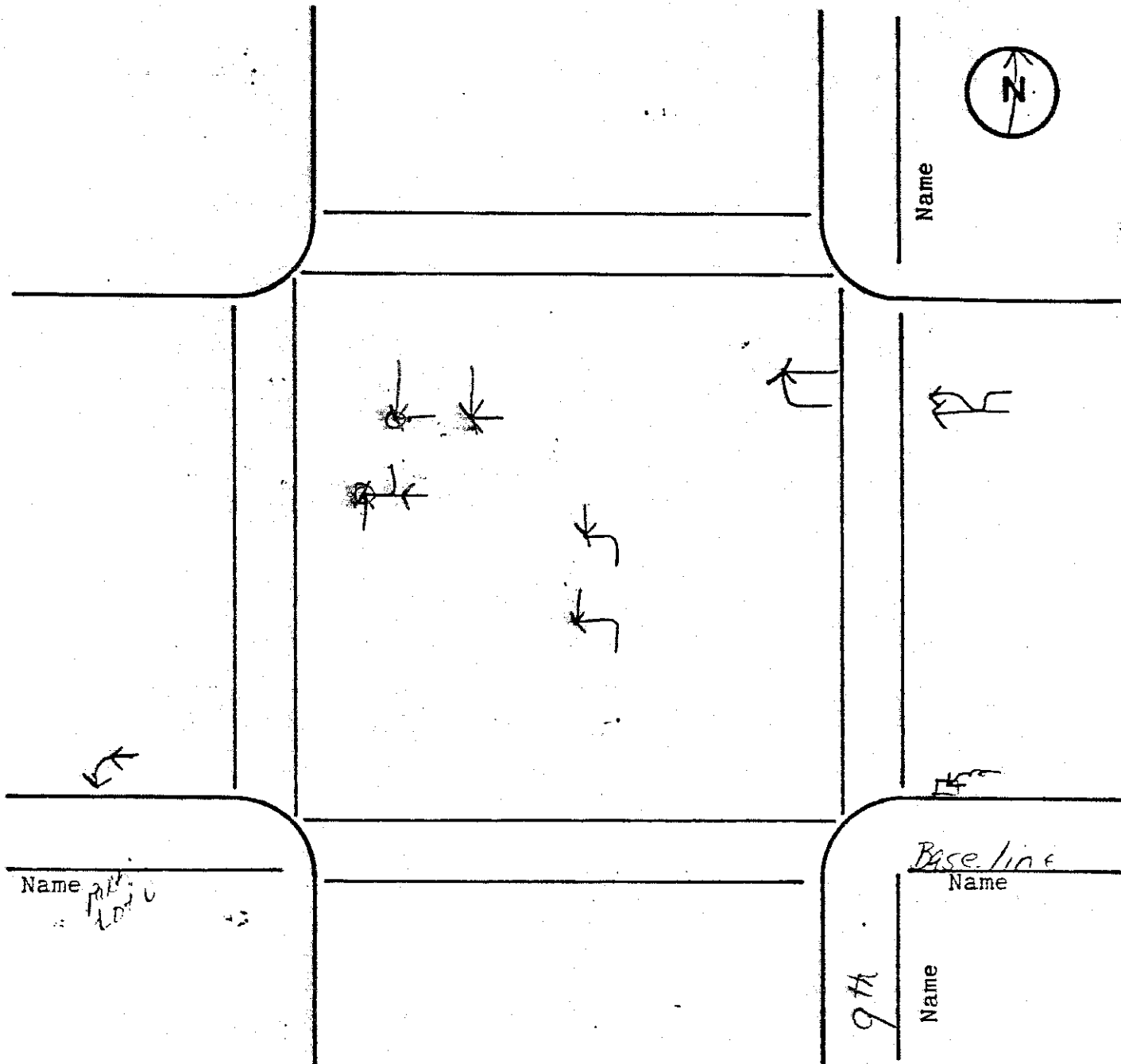
INTERSECTION: N. E. 28<sup>th</sup> + Cornell Rd.



| NUMBER OF ACCIDENTS |                      |   |                 |
|---------------------|----------------------|---|-----------------|
| <u>3</u>            | Property Damage Only | ← | Moving Vehicle  |
| <u>6</u>            | Injury or Fatal      | ↔ | Backing Vehicle |
| <u>9</u>            | Total Accidents      | X | Pedestrian      |
|                     |                      | ⊗ | Bicycle         |
|                     |                      | ▢ | Parked Vehicle  |
|                     |                      | ● | Fixed Object    |
|                     |                      | ○ | Fatal Accident  |
|                     |                      | ○ | Injury Accident |
|                     |                      | ↔ | Rear End        |
|                     |                      | X | Head On         |
|                     |                      | ↔ | Side Swipe      |
|                     |                      | ↔ | Out of Control  |
|                     |                      | ↔ | Left Turn       |
|                     |                      | ↔ | Right Angle     |

# COLLISION DIAGRAM

INTERSECTION: 9th + Baseline



| NUMBER OF ACCIDENTS           |                   |                  |
|-------------------------------|-------------------|------------------|
| <u>7</u> Property Damage Only | ← Moving Vehicle  | ← Rear End       |
| <u>2</u> Injury or Fatal      | ↔ Backing Vehicle | * Head On        |
| <u>9</u> Total Accidents      | ✕ Pedestrian      | ↔ Side Swipe     |
|                               | ⊗ Bicycle         | ↔ Out of Control |
|                               | ▣ Parked Vehicle  | ↔ Left Turn      |
|                               | □ Fixed Object    | ↔ Right Angle    |
|                               | ● Fatal Accident  |                  |
|                               | ○ Injury Accident |                  |

# COLLISION DIAGRAM

(Red Baron)

INTERSECTION: N.E. Copnell Rd. + Entrance to Hillsboro Air Port

| NUMBER OF ACCIDENTS |                      |                   |                  |
|---------------------|----------------------|-------------------|------------------|
| <u>6</u>            | Property Damage Only | ← Moving Vehicle  | ← Rear End       |
| <u>2</u>            | Injury or Fatal      | ← Backing Vehicle | × Head On        |
| <u>8</u>            | Total Accidents      | × Pedestrian      | ← Side Swipe     |
|                     |                      | ⊗ Bicycle         | ← Out of Control |
|                     |                      | ⊞ Parked Vehicle  | ← Left Turn      |
|                     |                      | □ Fixed Object    | ← Right Angle    |
|                     |                      | ● Fatal Accident  |                  |
|                     |                      | ○ Injury Accident |                  |